Table 9-13 Chiller No.3

DATE	TIME	Voltage	Current	Frequency	Effective Power	Reactive Power	Apparent Power	Power Factor
		[V]	[A]	[Hz]	[kW]	[kvar]	[kVA]	
7-Jun	1:00:00	240.62	77.8	50.00	45.15	33.39	56.16	0.804
7-Jun	2:00:00	242.61	78.5	49.99	45.15	33.96	56.52	0.799
7-Jun	3:00:00	243.98	78.3	50.02	45.18	34.95	57.12	0.791
7-Jun	4:00:00	243.93	78.4	50.06	45.12	35.01	57.09	0.790
7-Jun	5:00:00	244.01	79.0	50.11	45.12	35.07	57.15	0.790
7-Jun	6:00:00	243.64	78.4	50.02	45.12	35.10	57.18	0.789
7-Jun	7:00:00	241.89	78.5	50.05	45.06	34.65	56.82	0.793
7-Jun	8:00:00	237.16	149.1	50.06	45.09	33.39	56.13	0.803
7-Jun	9:00:00	238.10	165.3	49.94	199.20	136.38	242.16	0.823
7-Jun	10:00:00	237.19	163.5	49.93	87.84	78.30	117.69	0.746
7-Jun	11:00:00	236.64	457.9	49.99	213.42	143.91	258.12	0.827
7-Jun	12:00:00	236.36	463.7	50.00	276.39	175.44	327.36	0.844
7-Jun	13:00:00	235.21	458.8	49.98	276.45	176.31	327.90	0.843
7-Jun	14:00:00	235.02	457.6	49.97	276.36	175.92	327.60	0.844
7-Jun	15:00:00	237.02	455.2	50.00	275.46	176.37	327.09	0.842
7-Jun	16:00:00	240.06	165.1	50.00	122.16	97.53	156.78	0.779
7-Jun	17:00:00	240.97	166.0	50.01	168.81	121.38	208.83	0.808
7-Jun	18:00:00	240.13	164.4	50.00	171.63	125.13	213.09	0.805
7-Jun	19:00:00	235.40	427.3	50.03	239.07	163.20	289.74	0.825
7-Jun	20:00:00	237.59	432.6	49.97	256.83	172.86	309.57	0.830
7-Jun	21:00:00	238.79	435.6	49.99	256.95	174.42	310.56	0.827
7-Jun	22:00:00	238.33	437.0	49.94	256.35	171.06	308.19	0.832
7-Jun	23:00:00	237.82	77.6	49.93	53.25	39.45	66.30	0.803
8-Jun	24:00:00	241.69	78.1	50.08	45.00	33.48	56.10	0.802

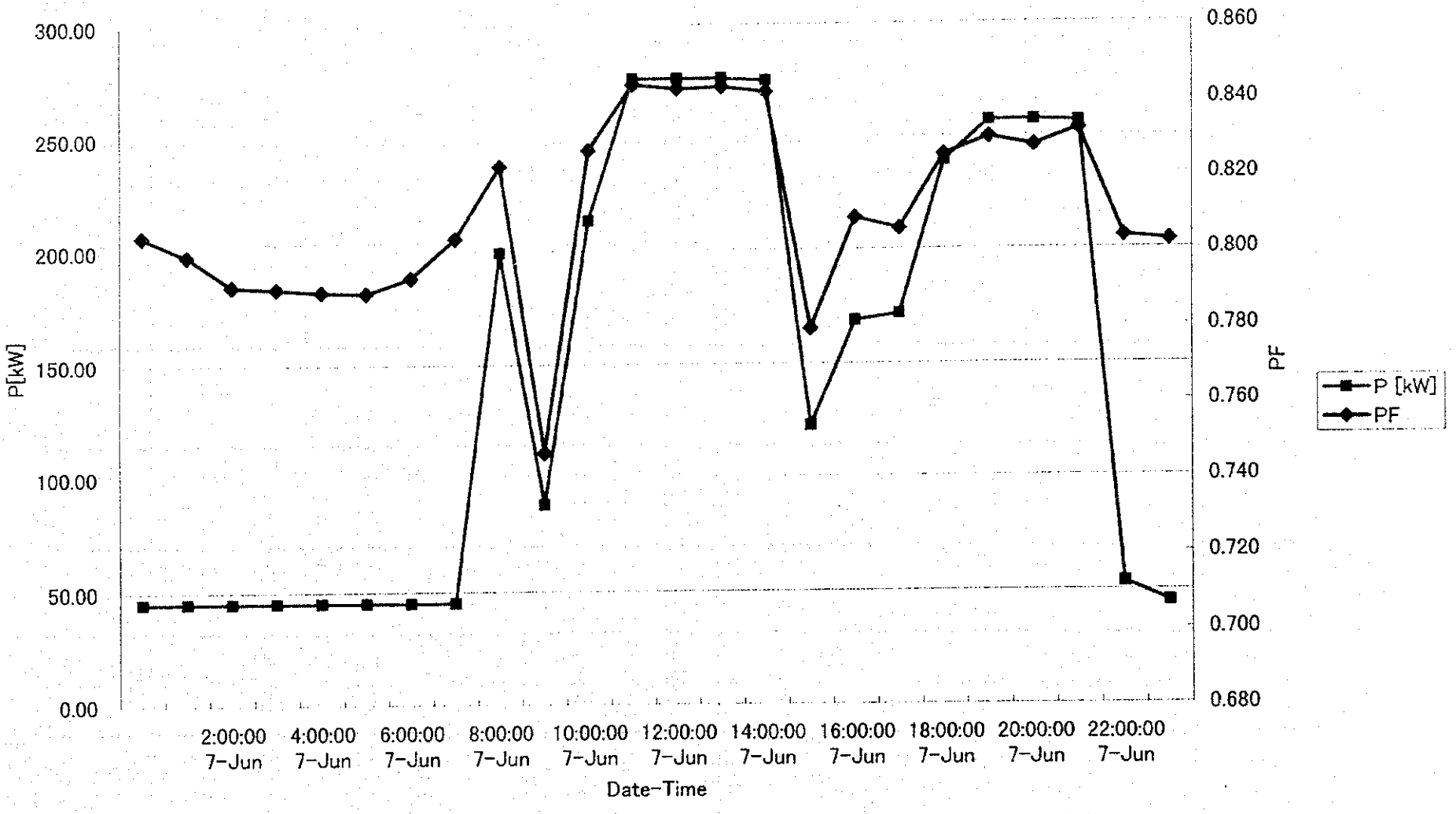


Figure 9-16 Chiller No.3 (Electricity-Power Factor)

Table 9-14 Passenger Lift

DATE	TIME	Voltage [V]			Current [A]			Frequency	Effective Power
		V1	V2	V3	I1	I2	I3	[Hz]	[kW]
10-Jun	16:00	241.43	240.21	240.86	8.65	9.65	7.32	50.02	32.19
10-Jun	17:00	240.01	238.29	237.91	8.53	9.65	7.42	50.03	27.64
10-Jun	18:00	237.33	235.08	235.75	34.71	53.52	61.65	50.05	28.83
10-Jun	19:00	238.97	238.25	238.78	8.24	9.85	7.40	49.98	27.61
10-Jun	20:00	239.05	238.78	239.05	8.42	9.67	7.03	49.95	34.67
10-Jun	21:00	242.10	241.26	241.51	8.42	9.62	6.97	50.02	23.73
10-Jun	22:00	240.93	240.06	240.62	8.41	9.66	6.96	50.04	20.96
10-Jun	23:00	243.83	242.72	243.29	8.53	10.01	7.12	50.01	29.78
11-Jun	0:00	240.80	239.30	240.32	8.31	10.06	7.24	49.98	27.56
11-Jun	1:00	242.13	241.16	241.74	8.41	9.68	6.98	49.93	19.25
11-Jun	2:00	240.46	239.77	239.15	8.24	9.61	6.80	50.05	18.83
11-Jun	3:00	242.73	272.02	243.02	8.43	9.62	6.99	50.01	14.20
11-Jun	4:00	243.35	242.64	243.43	8.27	9.31	6.74	50.00	14.96
11-Jun	5:00	243.61	242.79	243.65	8.40	9.51	6.74	50.05	13.24
11-Jun	6:00	242.78	241.73	242.56	8.42	9.61	6.87	49.96	13.68
11-Jun	7:00	238.07	237.15	237.08	8.72	9.69	7.34	50.01	17.11
11-Jun	8:00	239.95	238.56	239.47	8.23	9.59	7.25	49.96	33.95
11-Jun	9:00	239.76	238.60	239.01	7.22	10.27	16.44	49.97	35.91
11-Jun	10:00	236.39	235.04	235.99	9.21	9.68	7.26	49.98	27.86
11-Jun	11:00	239.95	237.23	238.71	8.45	37.30	29.91	49.98	26.66
11-Jun	12:00	233.96	233.46	233.80	14.69	20.56	15.57	50.08	22.54
11-Jun	13:00	233.17	232.67	233.79	8.54	9.70	7.31	50.02	24.89
11-Jun	14:00	232.38	231.95	233.93	43.20	45.71	28.84	49.89	26.06
11-Jun	15:00	235.80	235.47	235.91	22.73	10.34	32.05	50.04	30.16

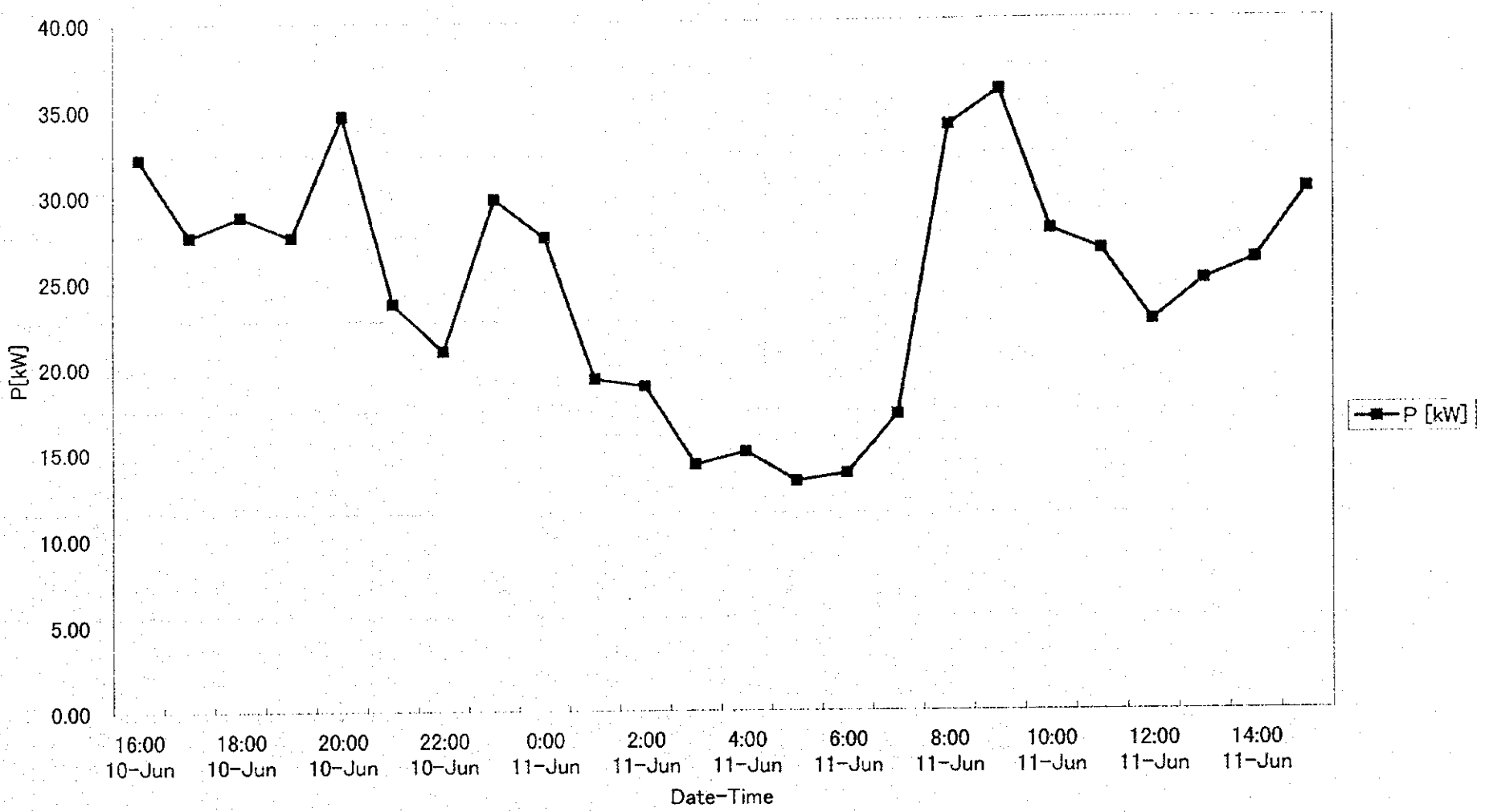


Figure 9-17 Passenger Lift (Electricity)

Table 9-15 Service Lift

DATE	TIME	Voltage [V]			Current [A]			Frequency	Effective Power
		V1	V2	V3	I1	I2	I3	[Hz]	[kW]
10-Jun	16:00	242.21	240.63	241.06	4.97	5.85	5.35	50.02	25.71
10-Jun	17:00	242.40	240.73	241.30	5.14	6.04	5.61	50.03	28.67
10-Jun	18:00	235.76	234.29	236.94	104.09	126.95	63.60	50.06	25.78
10-Jun	19:00	240.00	238.87	239.12	5.35	6.19	5.61	49.99	15.13
10-Jun	20:00	239.70	239.26	238.94	10.05	6.05	14.90	49.95	21.09
10-Jun	21:00	242.78	241.70	241.67	5.93	6.09	10.86	50.03	19.38
10-Jun	22:00	241.82	240.50	240.89	5.35	6.23	5.64	50.03	10.91
10-Jun	23:00	244.66	243.33	243.60	5.38	6.32	5.73	49.99	17.06
11-Jun	0:00	241.68	240.05	240.69	4.98	5.85	5.32	50.03	34.54
11-Jun	1:00	242.70	241.42	241.93	5.23	6.23	5.64	49.93	10.14
11-Jun	2:00	242.89	241.52	241.34	5.36	6.25	5.64	50.04	10.67
11-Jun	3:00	243.67	242.64	243.27	5.34	6.26	5.65	50.02	3.62
11-Jun	4:00	244.12	243.11	243.69	5.33	6.27	5.63	50.00	4.78
11-Jun	5:00	244.32	243.27	243.88	5.37	6.28	5.68	50.06	3.10
11-Jun	6:00	243.47	242.29	242.82	4.98	5.91	5.39	49.99	6.92
11-Jun	7:00	240.26	238.50	239.20	5.36	6.21	5.63	49.98	10.92
11-Jun	8:00	238.82	236.90	239.57	79.25	105.42	67.63	49.94	19.13
11-Jun	9:00	240.66	238.89	239.61	4.99	5.84	5.34	49.95	29.10
11-Jun	10:00	234.22	233.29	234.32	111.97	112.39	111.10	49.99	23.79
11-Jun	11:00	240.10	238.70	238.77	24.68	5.72	29.30	49.99	25.31
11-Jun	12:00	235.17	234.29	234.71	4.99	5.74	5.30	50.06	22.12
11-Jun	13:00	235.27	234.68	234.50	19.31	5.96	23.85	50.03	26.13
11-Jun	14:00	233.44	233.14	235.56	99.39	119.57	59.35	49.90	25.49
11-Jun	15:00	237.89	236.83	237.52	5.34	6.16	5.63	50.02	29.14

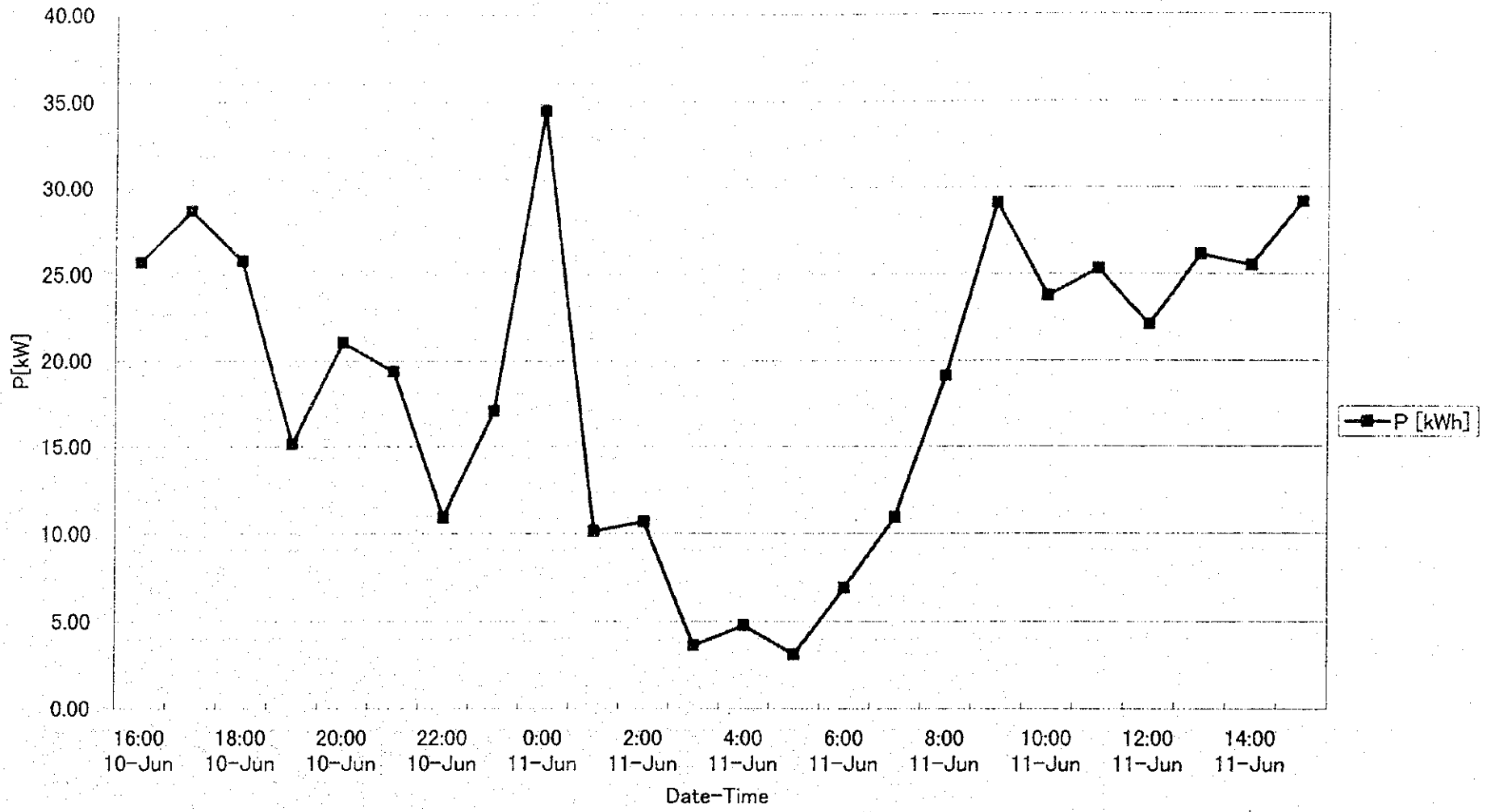


Figure 9-18 Service Lift (Electricity)

Table 9-16-(1) Distribution Board

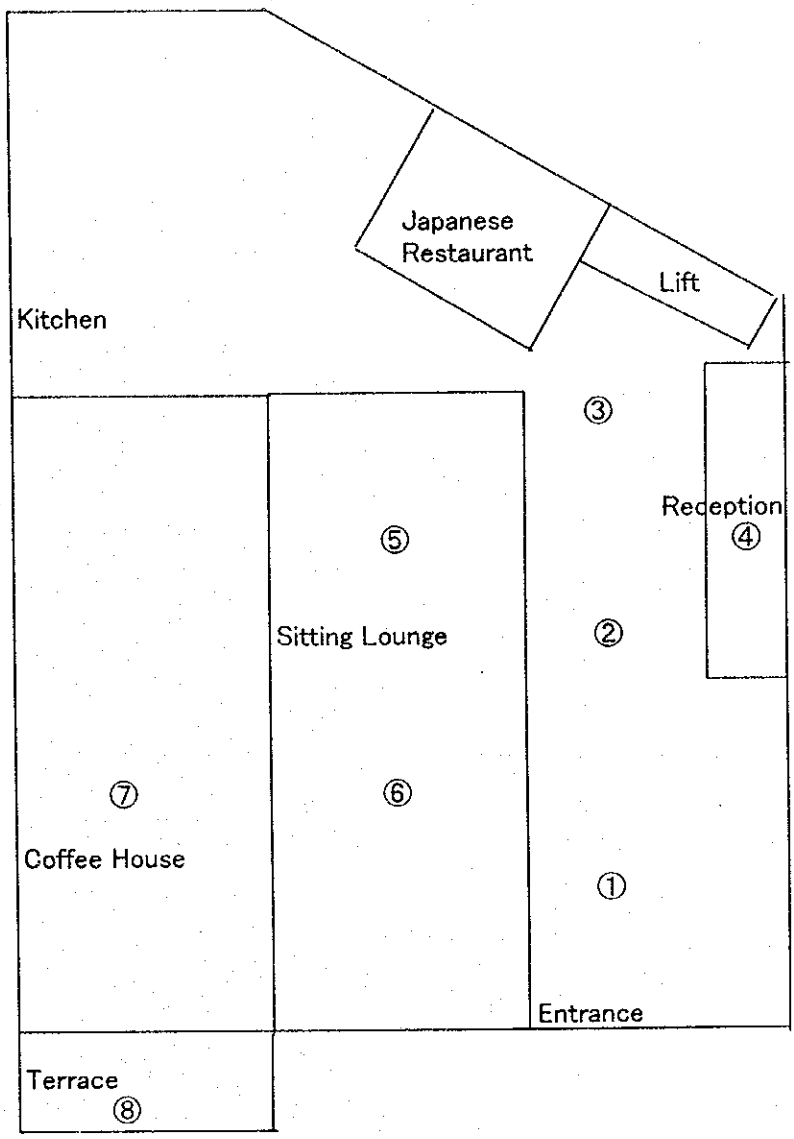
Use	Lihting, Consent			AHU				Others			Venti. Fan		
Phase	R	Y	B	N	R	Y	B	R	Y	B	R	Y	B
DB No.	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]
DB12-E1	8.24	7.80	8.99	2.23	3.46	3.42	3.39						
					3.51	3.53	3.54						
DB12-1	10.06	12.76	13.48	3.02									
	5.97	0.00	1.56										
	0.00	0.00	7.31										
DB11-E1	4.44	4.83	5.53		4.47	4.06	4.52						
DB11-1	3.92	11.59	4.79										
DB10-E1	4.50	5.01	5.98		4.43	4.47	4.43						
DB10-1	8.03	2.92	3.29										
DB09-E1	4.62	5.34	6.02		4.61	4.60	4.59						
DB09-1	2.62	2.52	3.59										
DB08-E1	4.55	5.07	6.08		4.54	4.52	4.51						
DB08-1	2.95	5.04	3.61										
DB07-E1	0.00	0.61	1.77										
DB07-1	5.14	3.82	3.89										
DB06-E1	0.00	0.83	1.72										
DB06-1	6.48	3.20	4.29										
DB05-E1	4.67	5.27	5.98		4.65	4.58	4.61						
DB05-1	2.42	3.79	4.08										
DB04-E1	0.00	0.71	1.80										
DB04-1	3.20	1.90	3.94										
DB03-E1	4.16	4.72	8.09		4.16	4.06	4.12						
DB03-1	3.81	3.38	4.36										
DB02-E1	1.26	2.66	2.60										
DB02-1	5.86	4.64	4.20	3.85	5.86	4.64	4.20	5.86	4.64	4.20			
DB01-E1				6.91	3.83	3.82	5.47						
DB11-E2	4.05	3.70	4.08	0.67	3.47	3.39	3.38						
DB11-2	2.82	3.16	3.31										
DB10-E2	0.00	0.00	1.06	1.05									
DB10-2	2.29	3.98	4.88	2.36									
DB09-E2	0.75	0.14	0.67	0.54									
DB09-2	2.37	5.14	3.83	2.30									
DB08-E2	5.61	4.46	5.15	1.18	4.48	4.47	4.42						
DB08-2	5.08	6.03	5.42										
DB07-E2	4.66	5.18	5.35	0.47	4.67	4.52	4.48						
DB07-2	5.09	6.45	5.39										
DB06-E2	5.28	5.40	4.38	1.02	4.48	4.44	4.38						
DB06-2	11.10	5.44	8.22	5.80									
DB05-E2	4.53	3.93	3.43	1.20	3.36	3.34	3.43						
DB05-2	4.03	8.54	4.82	4.08									
DB04-E2	4.35	4.54	3.45	1.35	3.50	3.50	3.46						
DB04-2	4.56	9.17	4.14	4.94									
DB03-E2	4.92	4.08	5.11	1.10	4.11	4.14	4.09						
DB03-2	4.79	6.90	6.10	3.09									
DB02-E2	8.50	8.75	8.49	1.75	7.83	7.71	7.73						
DB02-2	10.71	6.77	16.05	6.35									
DB01-E2	40	40	40								85	82.8	89.3
DB01-2				32.70	40.15	31.80	32.50	40.15	31.80	32.50			
DB01-E3				14.00	3.11	8.83	9.32	3.11	8.83	9.32			

Note: R / Red Y / Yellow B / Blue N / Neutral

Table 9-16-(2) Distribution Board

Use	Lihting, Consent			AHU				Others			Venti. Fan		
Phase	R	Y	B	N	R	Y	B	R	Y	B	R	Y	B
DB No.	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]
DBB1								36.50	24.20	7.36			
DBB2				8.06	35.60	32.00	28.80						
DBB3								7.56	5.40	4.88			
DBB4								4.15	3.20	20.30			
DBB5								50.30	42.20	43.00			
DBG1					14.50	6.05	11.65	14.50	6.05	11.65			
DBG2								23.40	33.80	18.41			
DBG3					41.70	65.20	54.80						
DBG4					8.29	7.57	7.50	8.29	7.57	7.50			
DBEB2				3.04	4.56	3.49	1.79	4.56	3.49	1.79			
DBEB3					3.98	0.00	0.00						
DBEB4								1.52	0.00	2.76			
DBEB5								2.15	2.11	2.10			
DBEB6								0.00	0.00	0.00			
DBEB8								0.01	0.01	0.01			
DBEG1					7.37	4.37	9.34						
DBEG2					12.05	15.70	13.06						
DBEG3								7.21	3.16	2.89			
DBSPARE								13.25	13.10	13.33			
DBTENANT								33.60	35.90	28.00			
DBPS				5.14				8.00	3.02	3.01			
SPARE								13.25	13.10	13.33			

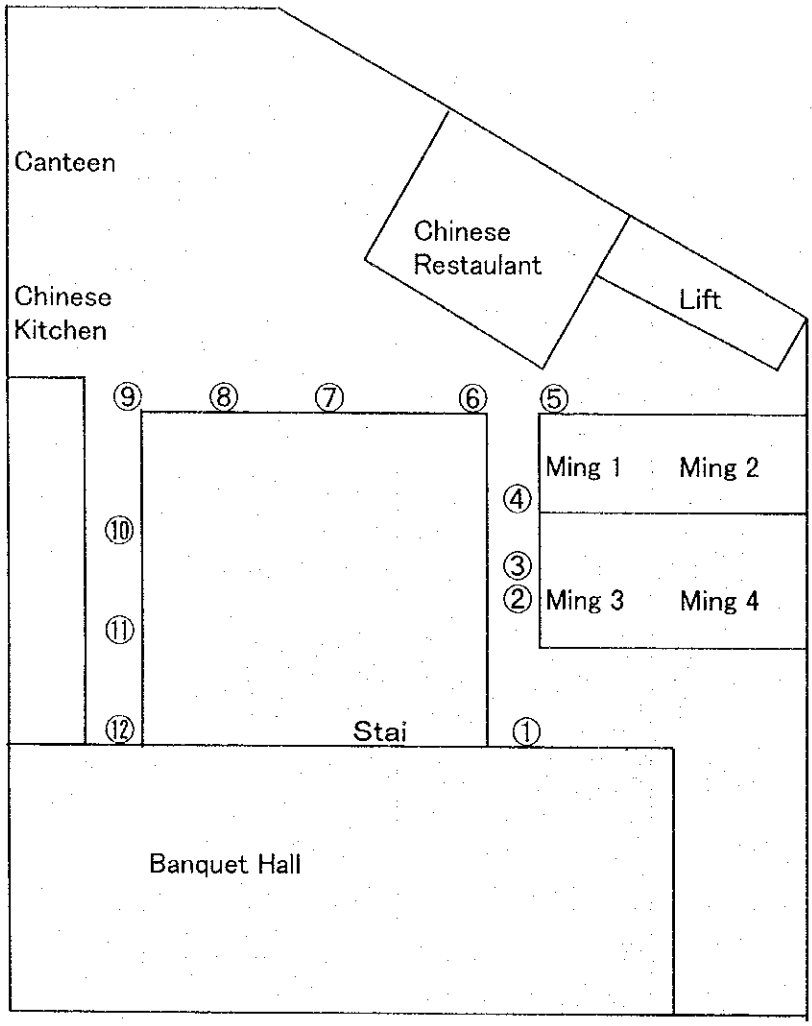
Note: R / Red Y / Yellow B / Blue N / Neutral



Location	Illumination Intensity	Temperature	Velocity
	lux	℃	m/s
1	132	24.6	0.17
2	91	22.8	0.24
3	113	23.8	0.17
4	169	23.1	0.22
5	722	23.7	0.03
6	82		
7	51		
8	281		

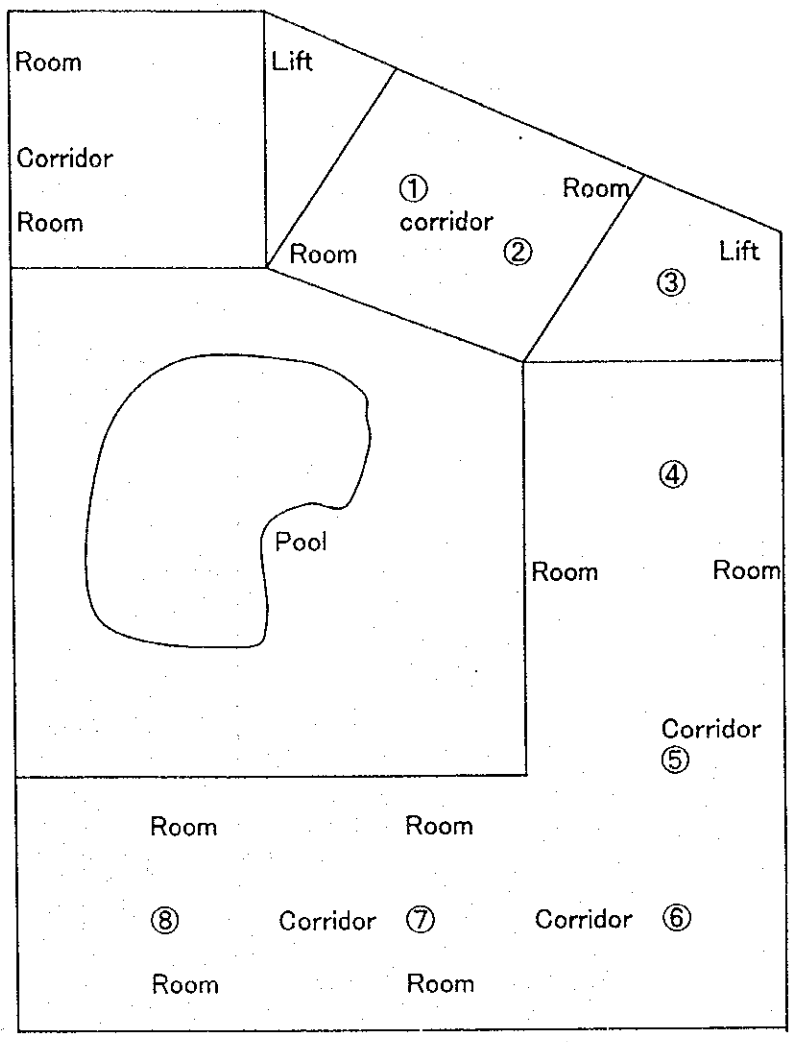
Figure 9-19-(1) Illumination Intensity on Ground Floor

Illumination Intensity in the Hotel



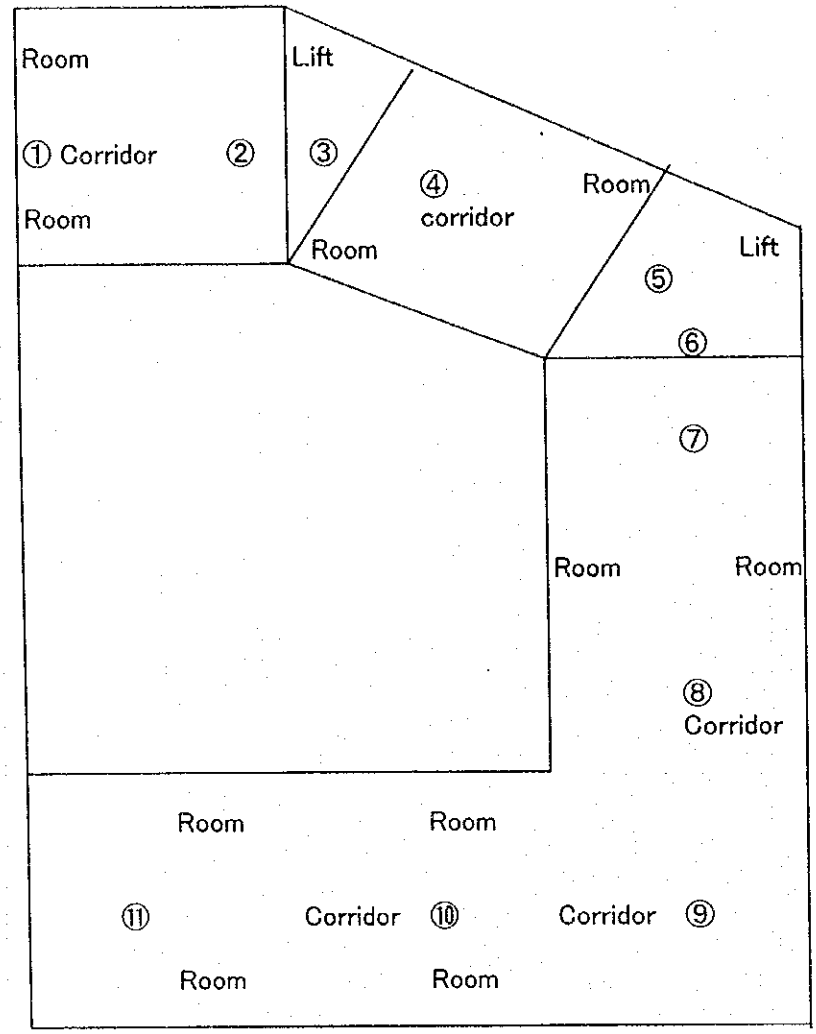
Location	Illumination Intensity	Temperature	Velocity
	lux	℃	m/s
1	155	24.9	0.13
2	77		
3	225		
4	103	25.0	0.04
5	96		
6	88	26.7	0.37
7	150		
8	67		
9	73	24.9	0.08
10	67		
11	188		
12	63	24.8	0.08

Figure 9-19-(2) Illumination Intensity on 1st Floor



Location	Illumination Intensity	Temperature	Velocity
	lux	℃	m/s
1	10	25.4	0.04
2	19	24.9	0.04
3	79	25.0	0.06
4	33	22.7	0.14
5	24	21.7	0.33
6	32	25.2	0.05
7	24	23.1	0.05
8	11	22.1	0.12

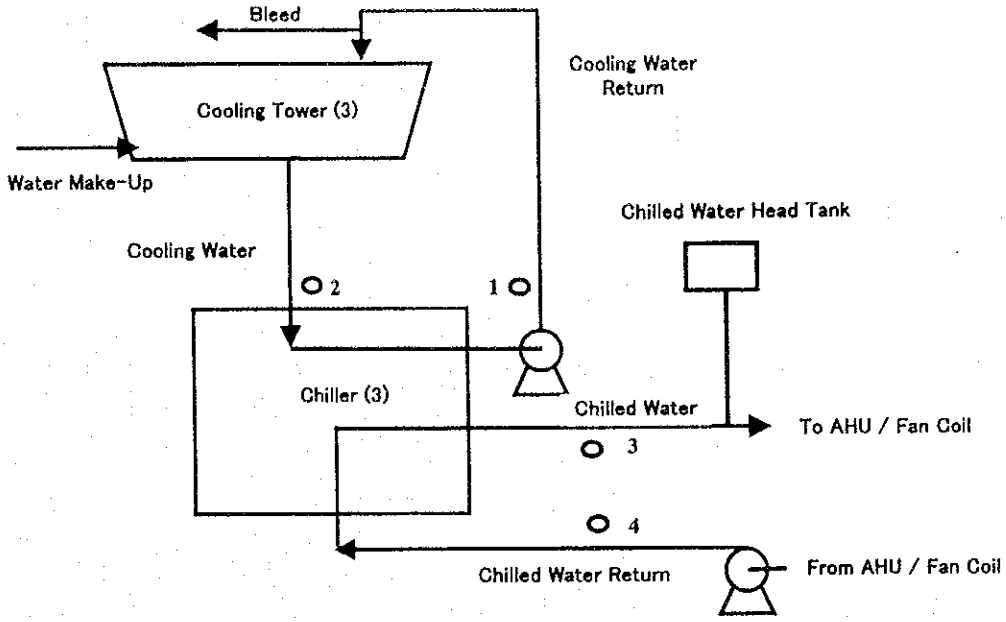
Figure 9-19-(3) Illumination Intensity on 2nd Floor



Location	Illumination Intensity	Temperature	Velocity
	lux	℃	m/s
1	30	24.4	0.00
2	33	24.1	0.03
3	11	24.2	0.05
4	11	24.1	0.07
5	103	24.9	0.04
6	100	25.4	0.03
7	37	25.4	0.03
8	32	25.3	0.05
9	35	25.8	0.04
10	12	25.6	0.04
11	107	26.2	0.02

Figure 9-19-(4) Illumination Intensity on 3rd Floor - 12th Floor

Chilled Water System



Data of Operation

Date	4/6/98							

Chiller No.2

Time		9:45	10:15	11:15	12:00	12:45	14:15	15:30	16:40
Temperature	℃								
1 Cooling Water Return	Bar	32.0			32.0	32.0	32.0	31.0	32.0
	Instrument	33.2	34.0	33.0	33.0	32.0	33.0	34.0	33.0
	Surface T	32.0			32.0	32.0	32.0	32.0	32.0
2 Cooling Water	Bar	29.7			29.0	30.0	30.0	28.0	29.0
	Instrument	29.0	32.0	31.0	31.0	31.0	31.0	32.0	31.0
	Surface T	31.5			30.0	30.0	30.0	30.0	30.0
3 Chilled Water	Bar	-	-	-	-	-	-	-	-
	Instrument	5.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0
	Surface T	-	-	-	-	-	-	-	-
4 Chilled Water Return	Bar	-	-	-	-	-	-	-	-
	Instrument	8.0	10.0	8.0	8.0	8.0	8.5	8.0	8.0
	Surface T	-	-	-	-	-	-	-	-

Chiller No.3

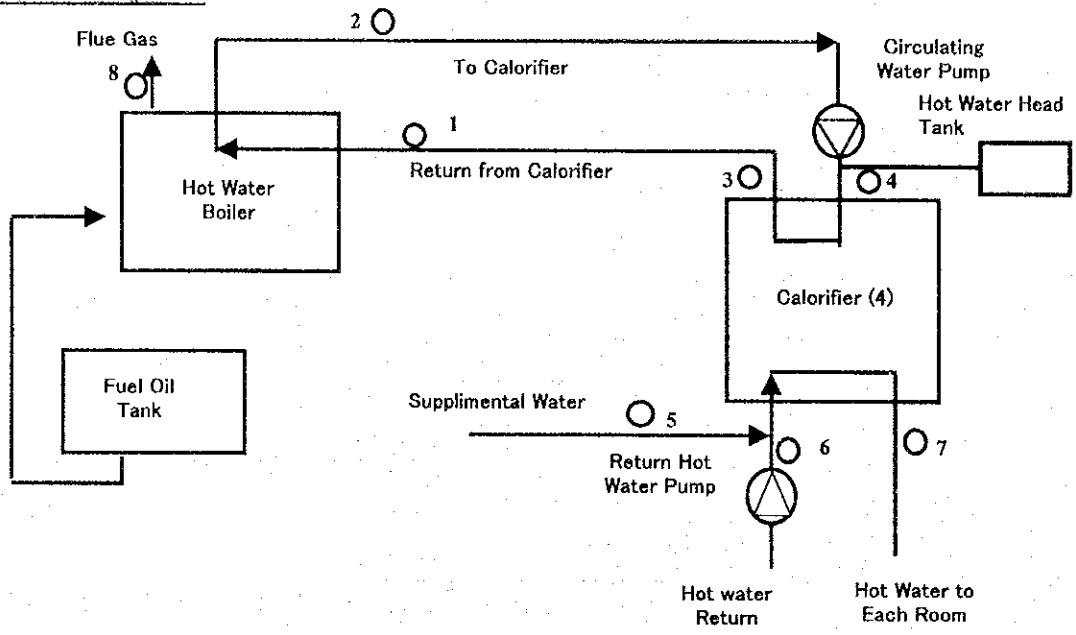
Time		10:45	11:15	12:00	12:45	14:15	15:30	16:40
Temperature	℃							
1 Cooling Water Return	Bar	31.0		31.0	32.0	32.0	31.0	31.0
	Instrument	34.0	34.0	33.0	33.0	34.0	34.0	33.0
	Surface T	31.0		32.0	32.0	33.0	33.5	32.5
2 Cooling Water	Bar	29.0		29.0	29.0	29.0	28.0	30.0
	Instrument	32.0	31.0	31.0	31.0	32.0	32.0	31.0
	Surface T	29.0		29.0	29.0	30.0	30.0	30.0
3 Chilled Water	Bar	-	-	-	-	-	-	-
	Instrument	6.0	6.0	6.0	6.0	6.0	6.5	6.0
	Surface T	-	-	-	-	-	-	-
4 Chilled Water Return	Bar	-	-	-	-	-	-	-
	Instrument	9.0	9.0	9.0	9.0	9.0	9.5	9.0
	Surface T	-	-	-	-	-	-	-

Cooling Tower

Time		10:00	11:00	12:00	12:45	14:15	15:25	16:30
Flow Rate								
2 Cooling Water Return	m^3/h	230	572	563	555	542	543	560

Figure 9-20 Chilled Water System

Hot Water System



Data of Operation

		Unit				
	Date		10/6/98	10/6/98	10/6/98	10/6/98
	Time		10.00	12.00	14.00	0:00
Temperature	Calorifier No					
1 Return from Calorifier		℃	69	69	68	64
2 Hot Water to Calorifier		℃	78	77	78	76
3 Outlet of Calorifier	1	℃	56	65	63	64
	2	℃	63	59	60	63
	3	℃	66	64	60	65
	4	℃	61	61	66	64
4 Inlet of Calorifier	1	℃	56	54	51	53
	2	℃	54	59	53	56
	3	℃	56	56	63	57
	4	℃	68	66	70	69
5 Supplementary Water (1)		℃	31	32	32	32
6 Hot Water Return from Each Room	1	℃	56	56	55	54
	2	℃	55	54	57	58
	3	℃	52	55	53	60
	4	℃	56	56	56	55
7 Hot Water to Each Room	1	℃	56	55	53	54
	2	℃	55	58	54	56
	3	℃	61	57	58	58
	4	℃	67	66	65	66

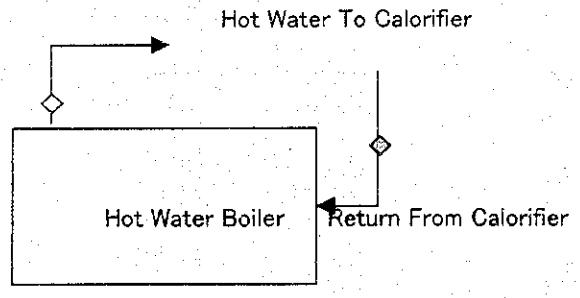
Flow Rate

	Time	12:00	12:27	14:30	15:08
1 Return from Calorifier	m3/h	38.8	1.6	17.8	18.2

Flue Gas Analysis	(Date: 9/6/1998)		Low	High
8 Contents	O2	Vol %	0.6	0.8
	CO2	Vol %	14.0	15.0
	CO	ppm	192	357
	NO	ppm	58	62
8 Temperature		℃	284	308

Figure 9-21 Hot Water System

Hot Water Boiler Operation



◇ Temperature Measurement Point
◈ Flow Rate Measurement Point

Flow Rate
Date: 5th June 1998
Boiler 2 in Operation

Cut IN	Cut Out	Duration
12:15	12:18	0.03
12:23	12:27	0.03
12:32	12:38	0.06
14:10	14:15	0.05
14:32	14:43	0.11
15:03	15:08	0.05

Date 11th June 1998

Cut IN	Cut Out	Duration
9:40	9:44	0:04
9:47	9:51	0:04
9:57	10:00	0:03
10:05	10:14	0:09
10:17	10:21	0:04

Boiler Flow Rate

Time	m3/h
12:00	38.79
12:27	18.60
14:20	17.26
14:30	17.75
14:33	37.78
14:36	37.50
14:38	38.07
14:43	18.18
15:08	18.18
15:05	38.00
15:09	17.61

Hot Water Boiler Operation Comments

a) 24-Hr operation
b) For Rooms and sanitary facilities
c) Temp. Set Points : Low 76 C High 87/90 C
d) High burning when load is high
e) Load is highest in morning 7.00 am to 10.00 am and in evening.

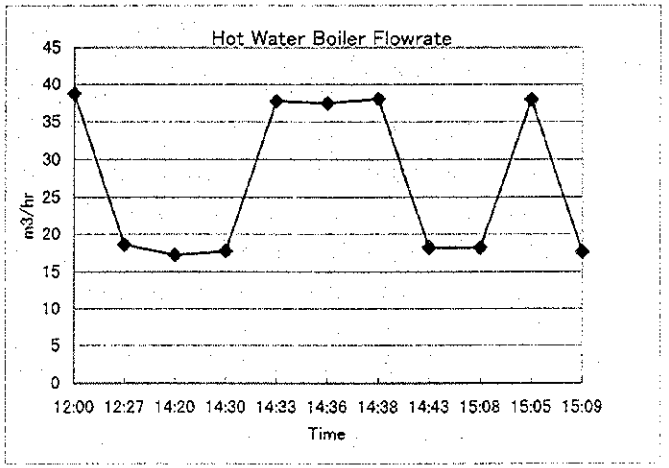
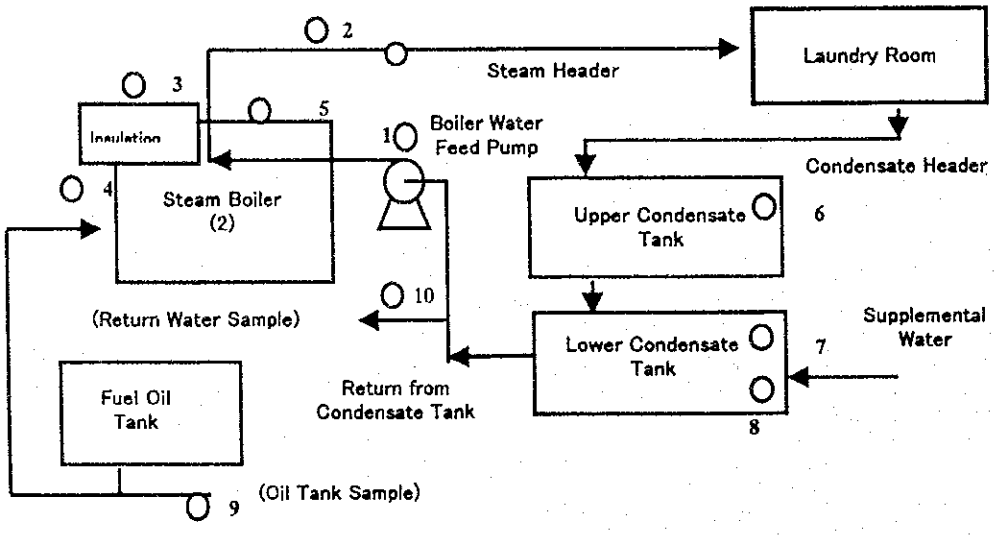


Figure 9-22 Hot Water Boiler Operation

Steam Boiler System



Data of Operation

	Date	11/6/98	11/6/98	11/6/98	11/6/98
	Time	10:42	14:15	15:15	16:15
Temperature	Calorifier No				
1 Return from Condensate Tank	℃	36	43	38	50
2 Steam Header	℃	162	153	137	126
3 Steam Boiler Surface Temp. with Insulation (Back)	℃	50	56	55	45
4 Steam Boiler Surface Temp. with Insulation (Front)	℃	105	115	118	88
5 Steam Boiler Surface Temp. without Insulation	℃	185	172	163	145
6 Upper Condensate Tank Surface Temp.	℃	93	87	93	93
7 Lower Condensate Tank Surface Temp. No.1	℃	90	78	90	55
8 Lower Condensate Tank Surface Temp. No.2	℃	32	34	34	36
Pressure					
2 Steam Header	Kg/cm2	8.5	7.5	7	3.25

Fuel Oil Consumption

9 Fuel Oil Receiving

Date	Counter Reading
27 / 5 / 98	426,906 liter
10 / 6 / 98	434,088 liter
Daily Consumption	513 liter
Yearly Consumption	184.7 Kiloliter

Boiler Feed Water Properties

10 Boiler Feed Water Sampling Nozzle

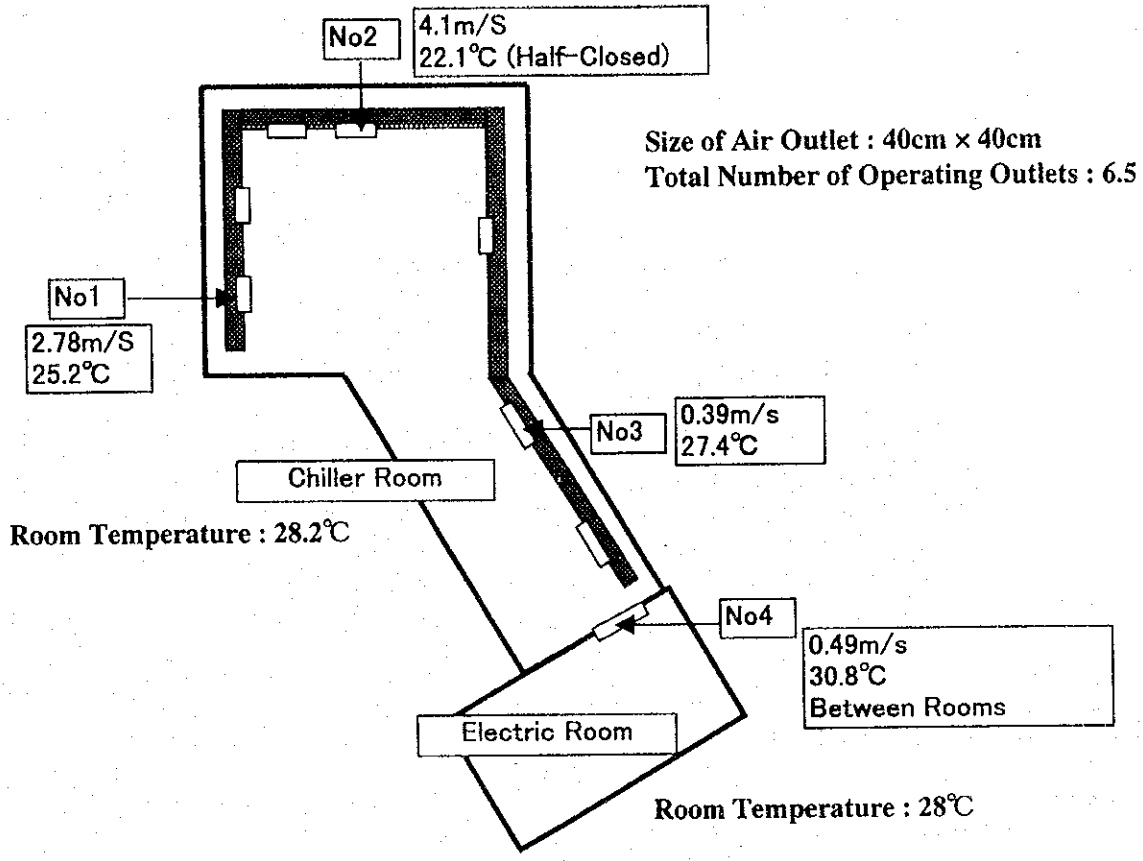
Date	Electrical Conductivity	PH
11 / 6 / 98	111.8 μs / cm at 24.7 ℃	8.8

Figure 9-23 Steam Boiler System

Inspection Result by JICA whole members on 11th June

Atmospheric Temperature : 33 to 34 ℃ (13:55)

(1) Chiller Room



Comments :

a. Temperature of Chiller Room could be controled by thermal switch, especially at night

(2) Kitchen

Room Temperature : 27℃

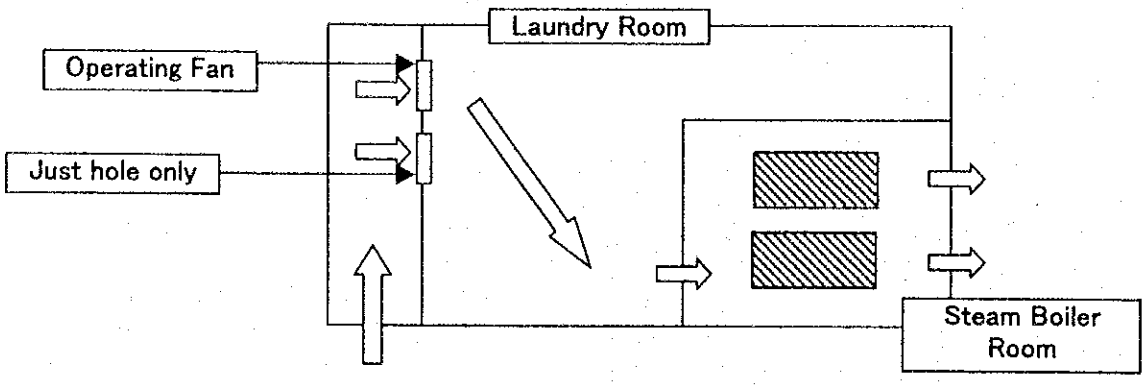
Flow rate : 1.27m/s

Comments

a. Chilled Air Fan could be controled by temperature switch.

Figure 9-24-(1) Air-Conditioning

(3) Steam Boiler Room



Room Temperature : 34 to 35℃

Comments

a. Air flow should be as shown above.
b. An additional fan should be installed between the corrider and Laundry Room.
c. A portable electric fan should be set at the end of corrider.
d. The steam boiler should have better insulation.
e. Spot cooling for laundry workers is effective.
f. From the back enterance at ground level, there is a significant amount of atmospheric air flow to base level. (Mesh doors should be replaced with closed type.)

(4) Hot Water Boiler Room

Comments

a. Fans could be operated by thermal switchs.

(5) Elevator Operation Room

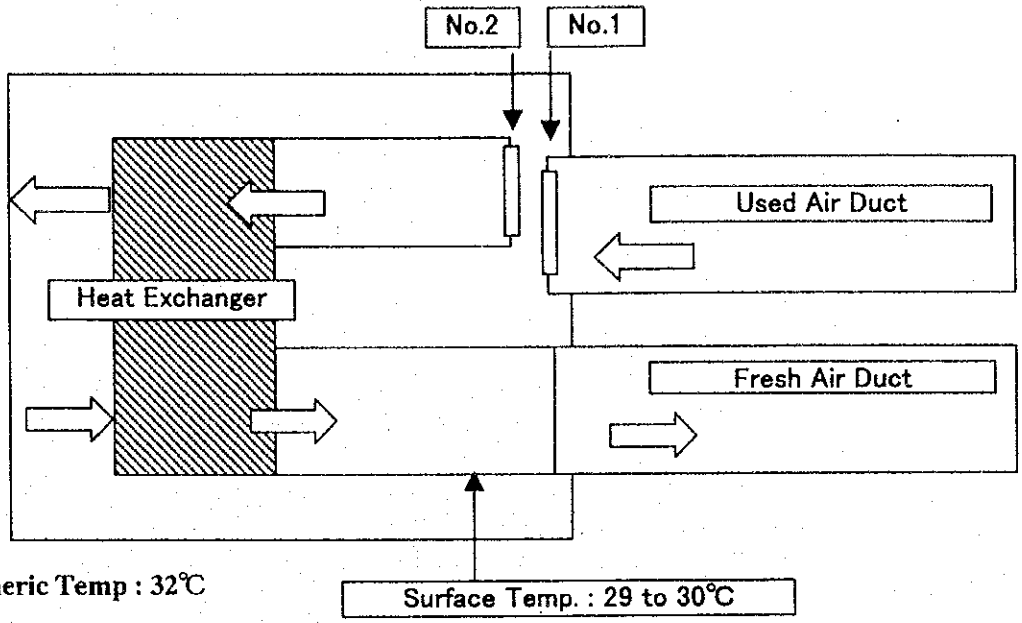
Room Temperature : 23℃

Comments :

a. Fans could be controled by thermal switchs.

Figure 9-24-(2) Air-Conditioning

(6) Air Heat Exchanger Room



Atmospheric Temp : 32℃

		Temp. (S)	Flow Rate (m/s)	
No.1 hole	1	27.2	2.7	Hole Size :
	2	27.0	3.0	88cm×171cm
	3	27.4	3.2	
	4	26.8	2.6	
	5	26.4	3.2	
	6	27.0	2.7	
No.2 hole	7	27.4	1.7	Hole Size :
	8	27.4	3.1	81cm×122cm
	9	27.0	3.1	
Average		27.1	2.8	

Comments :

a. Soiling in Heat Exchanger is attributed to temperature difference.

Figure 9-24-(3) Air-Conditioning

Table 9-17 Temperature and Relative Humidity, CO-CO_2 in Rooms and Atmosphere

Date		Office			Security Room			Lobby	Atmos.
Day	Time	Dry bulb Temp. ℃	Wet bulb temp. ℃	Humi dity %	Dry bulb Temp. ℃	Wet bulb temp. ℃	Humi dity %	CO-CO_2 ppm	CO-CO_2 Ppm
6-4	9	23	21.5	87				CO 0	CO 0
	12	21.5	19	78				CO_2 50	CO_2 210
	14	21.5	18	75				(16:30)	(15:30)
6-5	10				26.8	25.5			
	12	21.5	19	78	28.0	26.0		CO 0	
	14				29.0	26.0		CO_2 120	
	16	21.5	19.5	78	29.0	26.0		(16:50)	
6-8	9	27	24	77	23	21.5	87		
	10				22	20.5	87		
6-9	9	23	21	83	23	21.5	83		
	14	21	18.5	77					
6-10	9	23.5	21.5	83					
	22	22	19	74					
6-11	10	22.5	20.5	78					
	11	22	20	82					
	12	22.5	20	78					
6-12	10	22	20	82					
	12	22	20	82					
	14	21	18.5	77.5					

Date-Time/Area		Chiller Room		Laundry Room	
		Dry Bulb Temp.℃	Wet Bulb Temp. ℃	Dry Bulb Temp. ℃	Wet Bulb Temp.℃
6-5	10	26.4	22.4	32.2	29.2
	12	26.4	22.4	33.0	28.0
	14	26.0	22.0	34.0	28.0
	16	26.0	22.0	34.0	28.0

Table 9-18 Temperature Trend Data of Office, Room and Atmosphere

(℃)

	Office			Room	Atmosphere
Date / Hr.	June 8	June 9	June 10	June 12	June 5
10	22.5			25.5	
12	23	22	22	25.5	
14	22.5	22	24	25.5	29
16	23	22	22.5	26	24
18	23	24	24	26	25
20	24	24	25	26	25.5
22	24.5	25	25	26	25.5
24	24.5	25	25	26	26
2	25	25	25	25	26
4	25	25	25	25	26
6	25	25	25	24	26
8	25	25	25	23	26
10	25	25	25	22	
12		25	23		
Comment				Set Temp. 24	14:40 Squall

9-6 Results of Energy Audit

Based on existing data from the hotel, this section shows energy flow balance and unit consumption of energy.

9-6-1 Trends in Annual Energy Consumption by Energy Form

Consumption rates of electricity, diesel oil, LPG and water, and costs from 1995 to 1997 are shown in Table 9-19.

Table 9-19 Trends in Annual Energy Consumption and Costs

Name of utilities	Unit	1995		1996		1997	
		Consumption	Costs kRM	Consumption	Costs kRM	Consumption	Costs kRM
Diesel oil	k l	319.8	208	380.4	247	354.7	231
LPG	Ton	110.9	133	95.5	115	122.7	147
Electricity	mWh	7,302	1,675	8,937	1,963	9,568	2,074
(Peak)	mWh	4,381		5,362		5,741	
(Off peak)	mWh	2,921		3,575		3,827	
(Demand)	kW	1,265		1,265		1,265	
City water	kTon	198	237	190	228	163	196

9-6-2 Energy Flow in Hotel

Various types of energy including electricity, diesel oil and LPG were used in the major facilities of the hotel in 1997, as shown in Table 9-20. The percentages show the ratio of energy flow in the hotel. The percentage breakdowns in electricity and fuel consumption are based on the measured primary energy consumption calculated by actual data. Main energy consumers in the hotel were air-conditioning, lighting, lifts, sanitary facilities, cooking and the hotel laundry. The main energy source was electrical power, which accounted for about 83 percent of the total energy on a primary energy basis. All energy consumption is converted into kcal on a primary energy basis. Energy flow in the hotel is shown in Figure 9-25.

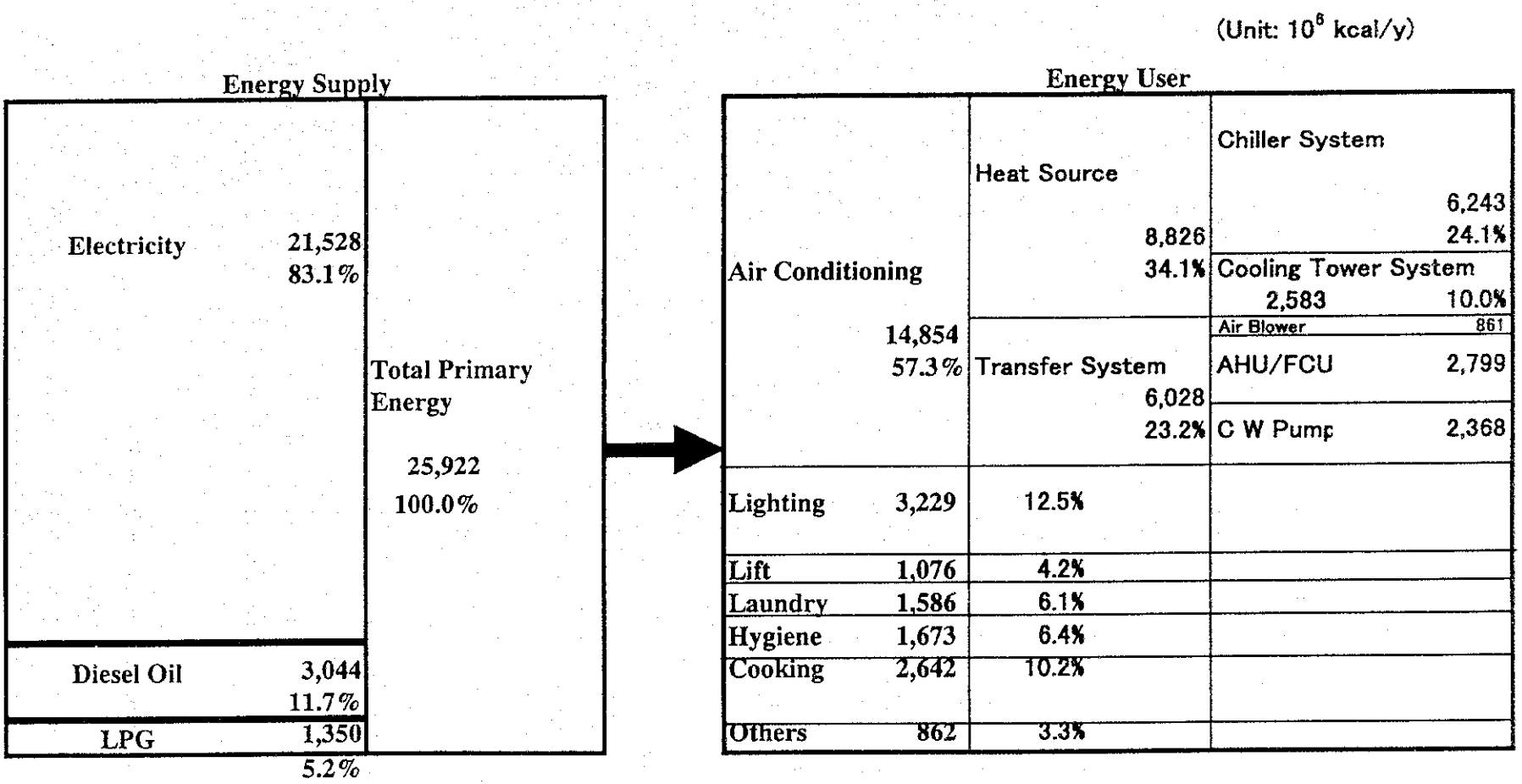


Figure 9-25 Primary Energy Flow in the Hotel

Table 9-20 Energy Flowchart of the Hotel

(Unit: 10^6 kcal/year)

Item	Electricity	Diesel oil	LPG	Total
The amount of consumption	(kWh) 9,568,000	354.7 (kl) 295.5 (ton)	(Ton) 122.7	
Primary energy 10^6 kcal	21,528 (83.1 %)	3,044 (11.7 %)	1,350 (5.2 %)	
Primary energy total	10^6 kcal			25,922 (100%)
Energy consuming facility				
Air-conditioning	14,854			14,854 (57.3%)
(1) Chiller system	6,243			6,243 (24.1%)
(2) Cooling Tower Sys.	2,583			2,583 (10.0%)
(2) Air Blower	861			861 (3.3%)
(3) AHU / Fan Coil U	2,799			2,799 (10.8%)
(4) Chilled Water Pump	2,368			2,368 (9.1%)
Lighting	3,229			3,229 (12.5%)
Lift	1,076			1,076 (4.2 %)
Steam boiler (Laundry)	-	1,586		1,586 (6.1%)
Hot water boiler/Calorifier (Hot water supply)	215	1,458		1,673 (6.4%)
Cooking / Restaurant	1,292		1,350	2,642 (10.2%)
Others	862			862 (3.3%)

(1997)

Assumption:

1. Conversion factor of electricity to primary energy: 2,250 kcal/kWh
2. Low heating value of LPG: 11,000 kcal/kg
3. Low heating value and specific gravity of diesel oil: 10,300 kcal/kg and 0.8332
4. Percentage of diesel oil consumption: steam boiler 52.1%, hot water boiler 47.9 %

9-6-3 Unit Consumption of Energy in the Hotel

Unit consumption of energy in the hotel is shown in Figure 9-26. Unit consumption is calculated based on the area of extended floor space in the hotel, 35,100 m^2.

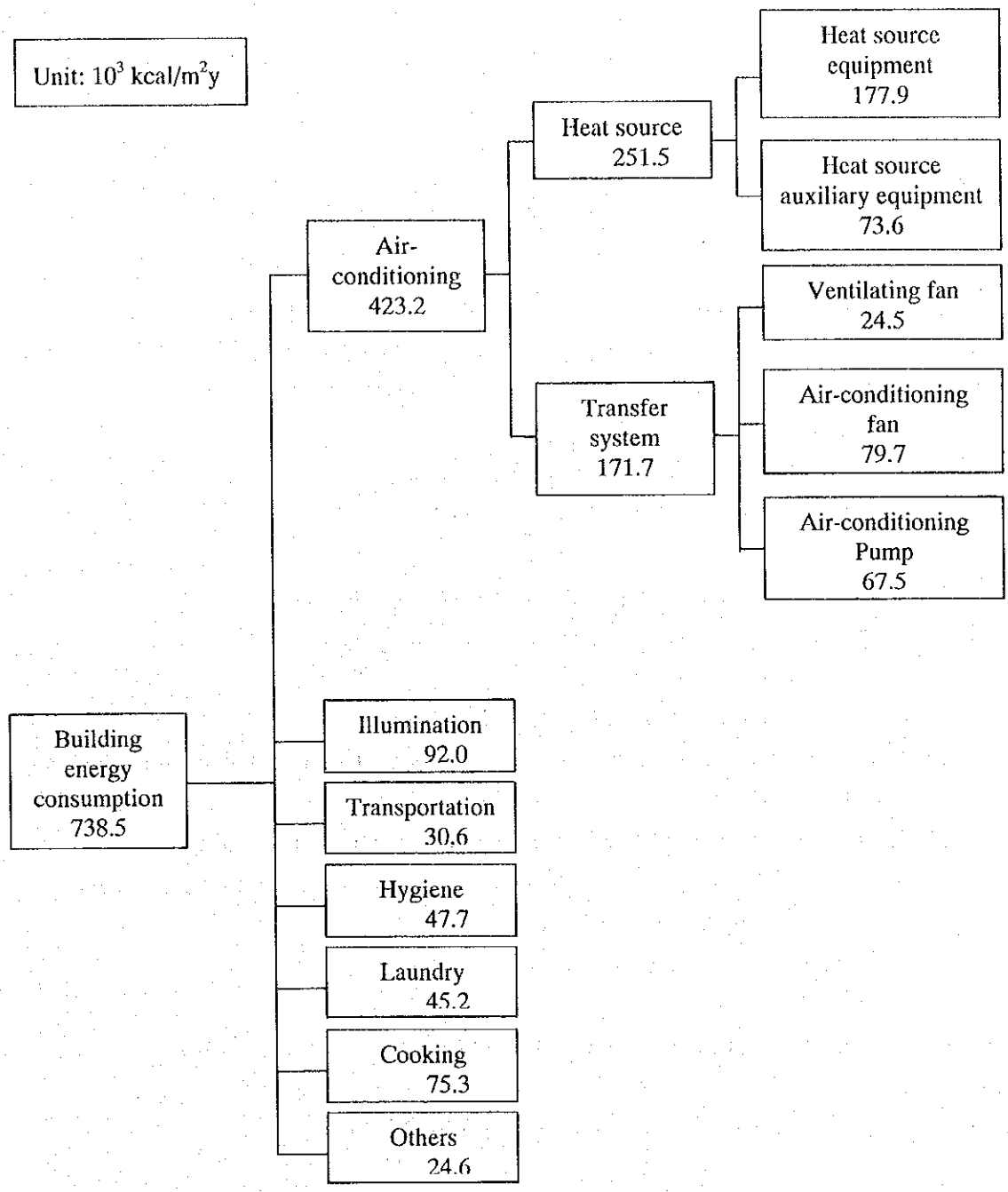


Figure 9-26 Unit Consumption of Energy in the Hotel

9-6-4 Present Situation of Energy Management and Energy Efficiency Promotion

The following types of problems are observed in terms of energy management.

(1) Establishment of Energy Efficiency Targets

Energy efficiency targets are not yet established, but energy costs are projected for each month. Quantitative control of energy is not conducted with a strict standard.

(2) Systematic Activities for Energy Management in the Organization

Under the advice of the manager, basic measures for energy efficiency promotion are being implemented. For example, lighting is switched on and off conscientiously.

(3) Energy Management Utilizing Data and Records

This type of management is not sufficiently implemented.

(4) Education and Training of Employees for Energy Management

The hotel has no experience in conducting such training and education.

(5) Maintenance Management of Building and Facilities

1) Dates for inspection and maintenance of equipment, facilities and buildings are not specifically determined.
2) Maintenance conditions. In terms of maintenance methods, there are two cases: one is routine work maintenance performed by permanent staff, and the other is the maintenance of specified facilities performed by consignor.
3) Periodic and long term maintenance plans are not drawn up.

(6) Measures Carried out for Energy Efficiency Promotion and Their Effects

There are no measures carried out for energy efficiency promotion in the hotel.

(7) Measures being Planned for Energy Efficiency Promotion and Their Anticipated Effects

The hotel is studying plans for electricity saving prepared by a consulting company in Malaysia, but investigations are in the preliminary stage.

(8) Business Condition of the Hotel

The hotel faces the intense competition of the hotel industry. It plans to reduce energy costs and decrease their percentage of the total cost; this applies particularly to electrical power charges.

(9) Problems in Promoting Energy Efficiency

1) Shortage of engineers
2) Insufficient data and lack of knowledge about energy efficiency promotion
3) Shortage of measuring equipment and operation data in the facilities.

(10) Environmental Pollution Management

The hotel does not have serious problems. There are minor troubles with waste gas and with waste water caused by sewage clogging in the hotel kitchen.

9-7 Measures for Energy Efficiency Promotion

In accordance with the energy audit results, measures to improve energy efficiency are described and discussed in this section. The major points are as follows.

1. Introduction of a heat storage tank for the chiller system
2. Improvement of power factor
3. Introduction of an inverter control system for the lift power supply
4. Improvement of the air-conditioning system
5. Improvement of the hot water system
6. Improvement of the steam boiler system

9-7-1 Introduction of Heat Storage Tank for Chiller System

(1) Current problems

As mentioned before, the difference between the electricity demand during the peak period and the off-peak period is large (approx. 400kW). The main cause for the difference is chiller No.3. As Figure 9-10 and Figure 9-11 show, the electricity of No.2 Transformer that supplies electricity to chiller No.3, fluctuates greatly. As Figure 9-16 shows, the difference between the peak and off-peak electricity of chiller No.3 is 230 kW.

At present, only the chilled water pump runs during the off-peak period and all equipment runs during the peak period.

(2) **Measures**

To address the difference in electricity consumption in Chiller No.3, a heat storage tank is recommended for its electricity cost-saving.

The chiller unit will run during the off-peak period (22:00 to 8:00) to make ice in the storage tank and to supply cooled air during the peak period (8:00 to 22:00). As a result, only the chilled water pump will be operated without chiller operation during the peak period.

An ice storage system is proposed as the heat storage tank for the chiller system. The system consists of an ice storage tank with a hair pin tube-type heat exchanger, a chiller using the brine as a coolant, a brine pump and a plate-type heat exchanger for chilling water by the brine.

The capacity will be as follows.

Ice storage tank capacity:	350 USRT	×	14 Hr / 24 Hr	=	204 USRT
Chiller capacity:	204 USRT	×	24 Hr / 10 Hr	=	490 USRT

(3) **Effect**

The operation of Chiller No.3 will be based on the following scheme:

The modeled current and new operational patterns are shown in Figure 9-27.

Table 9-21 New Operational Scheme of Chiller No. 3

Equipment	At Peak	At Off-Peak
Chiller No.3 (181 kW)	× Supplied by	○
Condenser water pumps (50 kW)	× heat storage tank	○
Chiller water pumps (47 kW)	○	○

Note: kW ... Motor Capacity, ○ : operated, ×: not operated

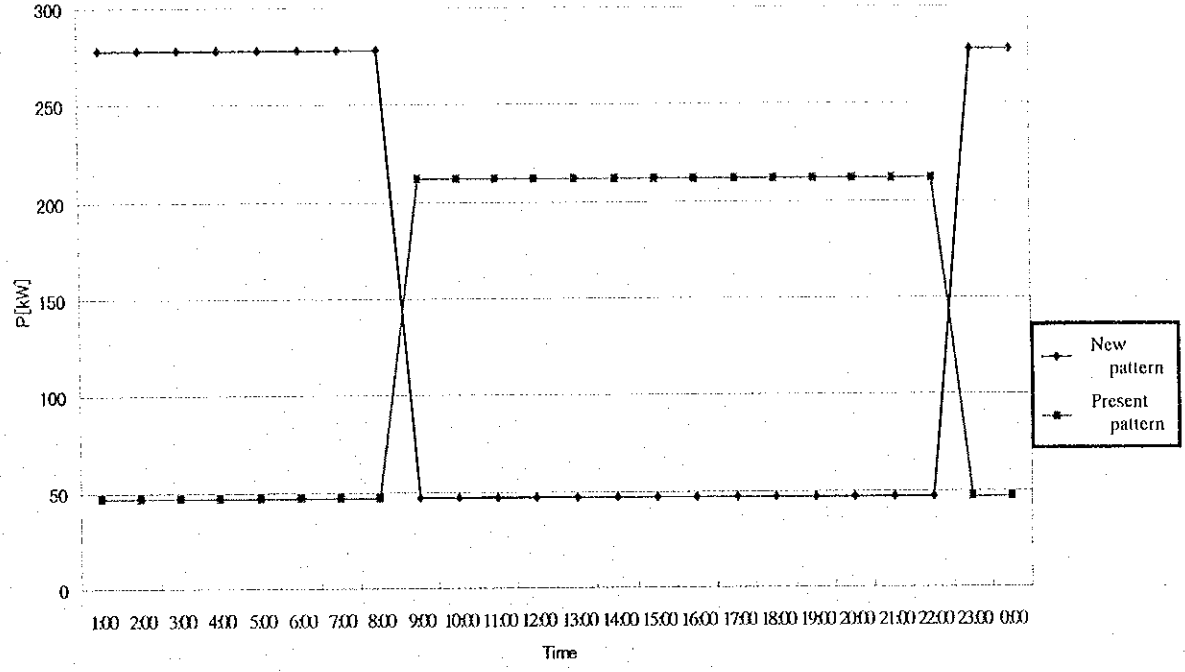


Figure 9-27 Chiller No.3 (Electricity)

As a result, electricity cost savings can be estimated as described in section 9-10.

9-7-2 Improvement of Power Factor

(1) Current problems

As Figure 9-9 shows, the power factor at the power receiving point dropped as electricity demand increased during the peak period. The drop in power factor was caused by the insufficient capacity of the condenser.

As Figures 9-10 and 9-11 show, the power factor at Transformer No.2 fell during the peak period as well, though it did not at 1.5MVA Transformer No.1.

(2) Measures

Based on the above situation, the condenser capacity at the Secondary Bus Bar of the 1.5MVA Transformer No.2 needs to be increased.

In order to improve the power factor up to 100 percent, it is necessary to install a condenser of 300 kVA, in accordance with the following formula;

$$\text{Condenser Capacity} = P\,\text{kW} \times \left(\sqrt{(1-\cos^2\theta 1)/\cos^2\theta 1} - \sqrt{(1-\cos^2\theta 2)/\cos^2\theta 2}\right)$$

$$= 575\,\text{kW} \times \left(\sqrt{(1-0.882^2)/0.882^2} - \sqrt{(1-1^2)/1^2}\right)$$

$$= 575 \times 0.5343 = 307$$
$$\fallingdotseq 300 \text{ kVA}$$

(3) Effect

The above measure will reduce the electricity transfer loss in the cable.

9-7-3 Introduction of Inverter Control System for Lift Power Supply

(1) Current problems

This hotel has seven lifts units with the specifications shown in Table 9-22.

Although all 7 lifts are old and the control system is based on relays, all lifts are in good working order and have been well maintained.

Table 9-22 Lift Specification

Control System	ACEE1-D	
Capacity	Lift No.1,2,3,4,6,7: Lift No.5:	17 persons 20 persons
Stops	Lift No.1,5,6,7: Lift No.2,3,4 :	14 stops 13 stops
Speed	105 m/min.	
Operation	Lift No.1,2,3,4: Lift No.5,6,7:	4C-OS75E 3C-OS75E

(2) Measures

To achieve further energy-efficiency of the lift power supply, it is recommended that the Variable Voltage Variable Frequency (VVVF) power supply system be introduced in the event of future lift renovation.

Instead of the current relay control system, the following control devices will be considered.

Table 9-23 shows the comparison of performance between the installed Ward-Leonard System (VVGD), VVVF and the AC feedback control system(ACEE).

(3) Effect

As Table 9-23 describes, VVVF is superior to other control systems in terms of power consumption, ease of maintenance and reliability, etc.

Table 9-23 Performance Comparison of Power Supply Control System

	VVGD (Ward-Leonard system)	VVVF (variable voltage variable frequency)	ACEE (AC feedback control system)
Riding Comfort	Good Simple feedback control without tachometer	Excellent Perfect continuous torque control and complete feedback control with pulse generator	Very Good Complete feedback control with tachometer. But, discontinuous torque control between motoring and braking
Landing Accuracy	Excellent	Excellent	Excellent
Noise	Large Starting noise of M-G set	Quiet Sine wave current controlled by PWM (Pulse Width Modulation)	Small Motor noise caused by thyristor controlled current
Power Consumption	Large Large consumption caused by M-G set	Very small, about half of ACEE Voltage and frequency control for induction motor at high efficiency	Small Static voltage control, but fixed frequency
Space for Machine Room	Large Large DC motor and M-G set	Very small Small sized single-winding AC motor and control panel	Small Small sized reconnect AC motor
Weight of Machine Room Apparatus	Large	Very small	Small
Reliability	Good Wear and tear of brushes and commutator of DC motor and M-G set	Excellent, superior to ACEE Solid state digital control by micro processor	Very Good Solid state control by analog devices
Response	Bad Time lag to start due to starting time of M-G set	Excellent No time lag to start	Excellent No time lag to start
Maintenability	Bad Required complex "compound adjustment"	Excellent No special adjustment	Very Good No complex adjustment

9-7-4 Improvement of Air-Conditioning System

(1) Present problems

1) AHU and total heat-exchanger

The heat exchange surface in the AHU and the entire exchanger are dirty.

2) Cooling towers

There is severe fouling in the cooling towers.

3) Air intake of the air-conditioning system

Fresh air intake is excessive in the hotel and significantly increases the power consumption of blowers and fans.

4) Room temperature setting

The temperatures of office rooms, corridors, restaurants and others are all 20-23℃.

In particular, temperatures in the machine room, electric switch room and the lift motor rooms are too low, even though the operators do not remain there continuously.

5) Door system

A large volume of outside air is coming into the hotel through the front door and the rear door on the ground floor.

(2) Measures

1) AHU and total heat-exchanger

The heat exchange surface in the AHU and the total exchanger must be cleaned periodically.

2) Cooling towers

Removal of algae from the packing in the cooling towers and the use of an adequate chemical agent such as an inhibitor are recommended.

3) Air intake of the air-conditioning system

It is recommended that a Variable Air Volume(VAV) system be installed for the hotel's air-conditioning. Various systems are used as control systems of intake air, such as damper control, vane control and various rotating speed controls, as shown in Table 9-24. Power consumption for each system is also shown in this table.

Table 9-24 Method of Variable Type Air Flow Control

Method	Sub-classification	Power Consumption
Damper Control	Discharge	Rank 1 (Largest)
	Intake	2
Vane Control	Intake	3
Control of Induction Motor Rotating Speed	Change of Number of Poles	4
	Control of Slip (Secondary Resistance Control System)	5
	Primary Frequency Control (VVVF)	6 (Smallest)

As rotating speed control by VVVF (Inverter control system) is easily available for existing motor facilities with considerable efficacy, it should be studied first among other possibilities for the motor of the fresh air intake blower in the total exchanger room for fresh air control.

4) Room temperature setting

The setting of room temperature should be raised by 2 - 3℃ for energy efficiency promotion.

It is recommended that a temperature control system be installed, such as fans with an on/off switch.

5) Door system

It is recommended that some air-tight entrance system be installed, i.e., double door system for the front entrance and automatic shut-off door for the back entrance.

9-7-5 Improvement of Hot Water System

(1) Current problems

On/off of firing operation in the boiler was too frequent and the duration of operation was short. This means that the boiler operation is not stable and the efficiency is low because incomplete combustion may be taking place. Not all four calorifiers were operated.

(2) **Measures & Effects**

It is recommended that the set temperature and both the low and high temperature set points of the primary water at the boiler outlet be checked, and that all the four calorifiers be operated as well. Furthermore, it is recommended that another new calorifier be installed to expand the capacity of the hot water system. The hot water boiler is not being operated efficiently on an ON-OFF switching basis, and the operation is frequently producing start-up and shut-down losses.

This operation should be made consistent, extending the capacity of the calorifiers, whose functions also include heat storage. Peak-shifting of electricity consumption will be possible after the installation of another calorifier.

9-7-6 Improvement of the Steam Boiler System

(1) **Current problems**

There was some exhaust steam from the relief valve due to leakage from the valve sheet and from the condensate tank due to vaporization of recovered condensate.

(2) **Measures & Effects**

It is recommended that adequate maintenance be carried out on the safety valve.

A heat-recovery system for steam vaporized from the condensate tank is also recommended for energy saving.

By sub-contracting laundry work in the hotel to an outside company, the hotel may be able to discontinue use of the steam boiler system, which will enable energy efficiency promotion and cost reduction.

9-7-7 Results of 101 Criteria for Further Improvement of Energy Efficiency

Based on discussions with the hotel, the evaluation results using 101 criteria for further improvement of energy efficiency are attached in Appendix (Table 9-A-10).

Among them, the items of Operation and Maintenance, Living Style and Others whose investment cost is not required are summarized as items worthy of being adopted.

(1) **Operation Management**

1) Fully or partially adopted items

a) Optimum Air-conditioning

- Introduction of frequent manual control for Air-conditioning

b) Restriction of Air-conditioning Operation

- Cessation of Air-conditioning for Unoccupied Rooms

c) On-off Control of Lighting System

- Reduction & Restriction of Lighting Hours before Working Time

d) Hot Water Supply

- Cut-off of Boilers & Hot Water Vessels according to Water Temperature

2) Recommended items worthy of adoption

a) Suction Air Control

- Reduction of Suction Air Volume during Air-conditioning
- Adjustment of suction air volume according to CO_2 content

b) Optimum Air-conditioning

- Introduction of Automatic Control for Air-conditioning
- Alternation of Setting Temperature for Water and Air Supply

c) Temperature & Humidity Conditioning

- Alternation of Setting Temp. & Humid. in the air-conditioned rooms
- Adjustment or Introduction of Schedule Control of Atmospheric Air

d) Restriction of Air-conditioning Operation

- Introduction of Local Air-conditioning (intensive air-conditioned area)

e) Air-conditioning Operation Management

- Adjustment of Setting Temperature & Pressure for Heat Source
- Adjustment of Number of Operating Heat Sources
- Control & Adjustment of Number of Operating Fans and Pumps

(2) Maintenance Management

1) Recommended items worthy of adoption

a) Maintenance

- Inspection & Repair of Air-leakage in Ducts
- Cleaning of Air-conditioner Coils & Filters
- Cleaning of Chiller Condensers & Evaporators
- Inspection & Repair of Automatic Control Instruments
- Repair & Exchange of Low Efficiency Equipment
- Monitoring System Reinforcement by Increasing Measuring Equipment
- Cleaning of Lighting Appliances and replacement of old lamps
- Increasing Lighting Efficiency by Cleaning Inner Surfaces of Rooms

b) Living Style

- Extinguishing Lights & dispersed Lighting in Corridors & Halls
- On-off Operation of Lighting Switches
- Extinguishing Lights near Windows
- Regular opening-closing of Blinds
- Regular closing of Front & Stairway Doors
- Publication and Request for Energy Conservation to Residents

9-8 Potential of Energy Efficiency Promotion

(1) Ice Storage System

Electricity consumption under existing conditions and that under the revised conditions after implementing this measure will be almost the same, as shown in Table 9-25. Total primary energy consumption in both cases will be the same. Therefore, the energy- saving potential of the measure is nill.

(2) Electric Condenser System in the Electricity Distribution

A 22.2-percent reduction in electricity loss from the power cable is expected by the installation of the condenser system. However, the reduction contributes very little to energy savings. The energy-saving potential per unit floor area is negligible.

(3) VVVF System in the Lifts

Compared with the energy consumption of lifts with the ACEE system that is used in the hotel, that of lifts with the VVVF system is generally about 50 percent. The electricity consumption of the existing lifts is 1,042 kWh/d. About 190,000 kWh/y of savings is expected by changing the lift control system.

(Saving amount = 1,042 × 0.5 × 365)

Energy saving potential is 428×10^6 kcal/y on a primary energy basis. The energy saving potential per unit floor area is 12×10^3 kcal/m^{2}y

(4) VAV System in the Air-conditioning

The saving in electricity consumption is estimated under the following assumptions.

1) A 30 percent reduction of fresh air intake is taken as the target.
2) Electricity consumption in the blower is proportional to the cube of the flow rate.
3) The power consumption of the existing blower is 949 kWh/d.

The saving in electricity consumption is estimated at 623 kWh/d or 227,000 kWh/y.

(Saving amount = $949 - 949 \times (1 - 0.3)^3$)

Energy-saving potential is 511×10^6 kcal/y on a primary energy basis. The energy-saving potential per unit floor area is 15×10^3 kcal/m^{2}y.

(5) Room Temperature Increase for Improvement of Air-conditioning System

The saving in electricity consumption is estimated under the following assumptions.

1) The target is to raise the temperature in rooms by 2 degrees centigrade by controlling the set temperature on the AHU.
2) A 10 percent reduction in electricity consumption for the air-conditioning system can be made generally by raising the temperature by one degree centigrade.
3) The electric consumption in the existing chiller system is 8,849 kWh/d.
4) The saving in electricity consumption is 646,000 kWh/y.

(Saving amount = 8,849 × 0.1 × 2 × 365)

Energy saving potential is $1,454 \times 10^6$ kcal/y on a primary energy basis. The energy-saving potential per unit floor area is 41×10^3 kcal/m^{2}y.

Effectiveness of the measures is summarized in Table 9-25 for peak and off-peak periods respectively.

Table 9-25 Energy Efficiency Improvements

(Unit: kWh/year)

Measures	Saving in electricity consumption in the peak period	Saving in electricity consumption in the off-peak period	Total saving in electricity consumption
1. Ice storage system	843,150	-843,150 (Increase)	0
2. Electric condenser system	nill	nill	nill
3. VVVF system in the lift	131,000	59,000	190,000
4. VAV system in the air-conditioning	132,000	95,000	227,000
5. Higher room temperature	377,000	269,000	646,000
Total	1,483,150	-420,150	1,063,000

9-9 Cost of Measures for Energy Efficiency Promotion

Budget-type costs as of November 1998 were estimated for the following three recommended modification proposals: 1) ice storage system, 2) VVVF system in the lift, 3) VAV system in the air-conditioning. The exchange rates used for estimation are 3.8 RM/US$, 118 Yen/ US$, the rates prevailing in November, 1998. The three measures are to be screened for financial evaluation, described in section 9-8 among the five technology selections. The cost for the electric condenser system is not considered here because its economical effect is nill. The cost for raising room temperature is not also considered, since no investment is necessary.

(1) Ice storage system

1)	Chiller	490 USRT 1 unit	34,300,000 Yen	1,104,000 RM
2)	Ice Storage	5,000 RTH, 9m×12m×4m	34,000,000 Yen	1,095,000 RM
3)	Exchanger, Tank, 2 Pump		5,000,000 Yen	161,000 RM
4)	Instrument		4,000,000 Yen	129,000 RM
5)	Piping Work		10,600,000 Yen	341,000 RM
6)	Electrical Work and Others		5,000,000 Yen	161,000 RM
7)	Total		92,900,000 Yen	2,991,000 RM

(2) VVVF system in the lifts

Cost of revamping for each lift is estimated as bellows.

Lift No.	Revamping Cost for each lift	Sub-total
1, 6, 7	297,000 RM	891,000 RM
5	315,000 RM	315,000 RM
2, 3, 4	290,000 RM	870,000 RM
Total		2,076,000 RM

(3) VAV system in the air-conditioning

1)	Inverter (200 v 45 k) 2 unit	4,000, 000	Yen	
2)	CO_2 Indicator and Controller 2 unit	60,000	Yen	
3)	Digital Controlling Unit 2 Unit	72,000	Yen	
4)	Total	4,132,000	Yen	133,000 RM

9-10 Benefit of Measures for Energy Efficiency Promotion

In this section, benefits are estimated of the measures for energy efficiency promotion, based on the current price of energy in Malaysia. Measures for which benefits are estimated are all measure that energy-saving potentials have been obtained in the previous section except that "Electric Condenser System in the Electricity Distribution" is excluded due to its very small energy-saving potential.

9-10-1 Current Price of Energy in Malaysia

Electric power could be saved by all the recommended measures for energy efficiency promotion. The current price of electric power conforms to category C2 of TENAGA NASIONAL's tariff, effective from 1 May, 1997, in the case of Mingcourt Vista Hotel. The following rates are applied, according to this category of tariff.

-Peak load rate (between 800 and 2200 hours):	0.208 RM/kWh
-Off-peak load rate (between 2200 and 800 hours):	0.128 RM/ kWh
-Maximum demand charge:	25.7RM/kW/month

9-10-2 Benefits of Measures

(1) Ice Storage System

The benefit derived from this measure is estimated at 118,338 RM/year by the calculations shown in Table 9-26 below.

Table 9-26 Estimation of Benefit from the "Ice Storage System" Measure

No.	Item	Estimated Value	Remarks
		Electricity Saving	
①	Reduction in peak demand	165 kW	= 212 – 47 (Fig. 9-27)
②	Increase in off-peak demand	231 kW	= 278-47 (Fig.9-27)
③	Electricity saving at peak time	843,150kWh/year	① x 14 h/d x 365 d/y
④	Electricity saving at off-peak time	- 843,150kWh/year	② x 10 h/d x 365 d/y
⑤	Saving in max. demand	165 kW/month	①
		Saving in Electricity Bill	
⑥	Electricity saving at peak time	175,375RM/year	③ x 0.208 RM/kWh
⑦	Electricity saving at off-peak time	- 107,923RM/year	④x 0.128 RM/kWh
⑧	Saving in max. demand charge	50,886RM/year	⑤x 25.7 RM/kW/m x 12 m/y
⑨	Saving in Electricity Bill	118,338RM/year	⑥ + ⑦ + ⑧

(2) VVVF System in Lifts

A 42,706 RM/year of benefit is estimated for this measure by the calculations shown in Table 9-27 below.

Table 9-27 Estimation of Benefit from the "VVVF System in Lifts" Measure

No.	Item	Estimated Value	Remarks
		Electricity Saving	
①	Electricity saving at peak time	131,000 kWh/year	Table 9-25
②	Electricity saving at off-peak time	59,000 kWh/year	Table 9-25
③	Saving in max. demand	25.6 kW/month	①/ 14 / 365
		Saving in Electricity Bill	
④	Electricity saving at peak time	27,248 RM/year	①x 0.208 RM/kWh
⑤	Electricity saving at off-peak time	7,552 RM/year	②x 0.128 RM/kWh
⑥	Saving in max. demand charge	7,906 RM/year	③x 25.7 RM/kW/m x 12 m/y
⑦	Saving in Electricity Bill	42,706 RM/year	④ + ⑤ + ⑥

(3) VAV System in Air-conditioning

The benefit of this measure is estimated at 47,582 RM/year, as Table 9-28 below shows.

Table 9-28 Estimation of Benefit from the "VAV System in Air-conditioning" Measure

No.	Item	Estimated Value	Remarks
	Electricity Saving		
①	Electricity saving at peak time	132,000 kWh/year	Table 9-25
②	Electricity saving at off-peak time	95,000 kWh/year	Table 9-25
③	Saving in max. demand	25.8 kW/month	①/ 14 / 365
	Saving in Electricity Bill		
④	Electricity saving at peak time	27,456 RM/year	①x 0.208 RM/kWh
⑤	Electricity saving at off-peak time	12,160 RM/year	②x 0.128 RM/kWh
⑥	Saving in max. demand charge	7,966 RM/year	③x 25.7 RM/kW/m x 12 m/y
⑦	Saving in Electricity Bill	47,582 RM/year	④ + ⑤ + ⑥

(2) Increase in Room Temperature

A 135,608 RM/year of benefit is estimated from this measure by the calculations shown in Table 9-29 below.

Table 9-29 Estimation of Benefit from the "Increase in Room Temperature" Measure

No.	Item	Estimated Value	Remarks
	Electricity Saving		
①	Electricity saving at peak time	377,000 kWh/year	Table 9-25
②	Electricity saving at off-peak time	269,000 kWh/year	Table 9-25
③	Saving in max. demand	73.8 kW/month	①/ 14 / 365
	Saving in Electricity Bill		
④	Electricity saving at peak time	78,416 RM/year	①x 0.208 RM/kWh
⑤	Electricity saving at off-peak time	34,432 RM/year	②x 0.128 RM/kWh
⑥	Saving in max. demand charge	22,760 RM/year	③x 25.7 RM/kW/m x 12 m/y
⑦	Saving in Electricity Bill	135,608 RM/year	④ + ⑤ + ⑥

9-11 Financial Evaluation of Measures

In this section, financial evaluations are made for the following measures based on investment in order to know the financial feasibility of the measures.

- Ice storage system
- VVVF system in the lift
- VAV system in the air-conditioning

The financial evaluations for the first and second measures are made under the assumption that the measures would be taken at a time when overage equipment was to be replaced by new equipment. Under such conditions, only the amount of money that would be used for energy-saving equipment is considered as fixed investment, in order to obtain the energy-saving benefit. The remaining invested money regarded as the replacement cost that is necessary, regardless of energy-saving.

In fact, the cost of a new chiller is excluded from the fixed investment for the purpose of the financial evaluation, assuming on ice storage system is introduced at the time of chiller replacement. As for the second measure, only the cost related to inverters is counted as the fixed investment for the purpose of the financial evaluation, assuming VVVF system lifts with inverters are introduced at the time of lift replacement.

The financial evaluation is not conducted for "Increase in Room Temperature" which is expected to generate large benefits, since this measure requires no investment.

9-11-1 Method of Financial Evaluation

(1) Applied Method

Two different methods, both widely used and accepted for financial evaluation of the investment projects, are applied in the study. The first method is the payback period method to calculate the payback period, defined as the period required to recover the investment outlay through the accumulated net cash flows earned by the project. The second method is the internal rate of return (IRR) method on a discounted cash flow basis. The Financial Internal Rate of Return on Investment (FIRROI) is defined the discount rate for which the present value of net receipts from the project is equal to the present value of the investment.

(2) Payback Period

Net cash flow is defined as follows:

1) Increased Sales Revenue
2) Less: Fixed Investment
3) Less: Pre-production Expenditure

4) Less: Increase in Net Working Capital
5) Less: Increased Operating Costs
6) Less: Increased Marketing Costs
7) Less: Increase in Corporate Tax Paid

In the case of the investment for energy improved efficiency, the change in sales revenue and marketing cost should be zero. The changes in net working capital and pre-production expenditure are negligible for the case of a project for improved energy efficiency. Fixed investment was estimated in the previous section. Changes in operating costs, which consist mainly of changes in utility bills such as electricity and fuel, were also estimated. Corporate tax change is calculated based on the change in taxable profit due to changes in operating costs in consideration of the country's tax rate, and depreciation system.

When calculating the payback period, a cash flow table starting from the construction period to the operating period is created. Accumulated net cash flow is negative during construction due to fixed investment and pre-production expenditure, however it will increase by the recovery of capital and become zero in a certain year. The payback period is defined as the period from the start of operation until the year when the cumulative net cash flow is zero.

(3) Internal Rate of Return (IRR)

The calculation procedure begins with the preparation of a cash flow table in the same way as the payback period method. Then, the discount rate when the cumulative net cash flow of the project becomes zero is obtained by trial-and-error. The thus discounted rate obtained is the Financial Internal Rate of Return on Investment (FIRROI).

9-11-2 Premises for Financial Evaluation

Financial evaluations are made on the following premises.

1) Exchange rate: US$ 1 = RM 3.8 ; US$ 1 = JY 118

2) Project life: 15 years from the start of operation

3) Corporate tax rate: 35 percent

4) Depreciation: The straight-line method is applied. The depreciation rate is 7.5%

per annum for the plant and machinery.

5) Fixed investment: Fixed investment cost, shown in Table 9-30 in Malaysian Dollars, converted from the Japanese Yen value in section 9-9, is used for the financial evaluation. As previously mentioned, for the first measure the cost of a new chiller is not counted in the fixed investment of the measure, assuming an ice storage system is installed at the time of chiller replacement. As for the second measure, only the cost related to inverters is counted in the fixed investment of the measure, assuming inverters are installed at the time of lift replacement.

Table 9-30 Fixed Investment for Measures

Measures	Fixed Investment, RM
Ice Storage System	1,887,000
VVVF System in the lifts	208,000
VAV System in the air-conditioning	133,000

9-11-3 Results of Financial Evaluation

Table 9-31 shows FIRROI before tax, FIRROI after tax and the payback period for the three measures. Estimated cash flow tables for these measures are presented in Tables 9-32 through 9-34.

Table 9-31 Results of Financial Evaluation

Measures	FIRROI before tax	FIRROI after tax	Payback Period
Ice Storage System	- 0.8%	- 0.5%	15.9 years
VVVF System in the lifts	19.0%	13.5%	6.3 years
VAV System in the air-conditioning	35.4%	24.9%	3.9 years

Table 9-32 Cash Flow Table (Measure: Ice Storage System)

Unit: RM

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Less: Fixed investment	1,887,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plus: Reduction in operating cost	0	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338
Less: Corporate tax increased	0	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	-8,115	24,907	41,418
Incremental Cash Flow (before Tax)	-1,887,000	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338	118,338
Incremental Cash Flow (After Tax)	-1,887,000	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	126,453	93,431	76,920
Cumulative net cash flow	-1,887,000	-1,760,547	-1,634,093	-1,507,640	-1,381,186	-1,254,733	-1,128,279	-1,001,826	-875,372	-748,919	-622,466	-496,012	-369,559	-243,105	-149,674	-72,755
Depreciation	0	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	141,525	47,175	0

Table 9-33 Cash Flow Table (Measure: VVVF System in the Lift)

Unit: RM

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Less: Fixed investment	208,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plus: Reduction in operating cost	0	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706
Less: Corporate tax increased	0	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	9,487	13,127	14,947
Incremental Cash Flow (before Tax)	-208,000	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706	42,706
Incremental Cash Flow (After Tax)	-208,000	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	33,219	29,579	27,759
Cumulative net cash flow	-208,000	-174,781	-141,562	-108,343	-75,124	-41,905	-8,686	24,533	57,752	90,971	124,190	157,409	190,628	223,847	253,426	281,185
Depreciation	0	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	5,200	0

Table 9-34 Cash Flow Table (Measure: VAV System in the Air-conditioning)

Unit: RM

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Less: Fixed investment	133,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plus: Reduction in operating cost	0	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582
Less: Corporate tax increased	0	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	13,163	15,490	16,654
Incremental Cash Flow (before Tax)	-133,000	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582	47,582
Incremental Cash Flow (After Tax)	-133,000	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	34,420	32,092	30,929
Cumulative net cash flow	-133,000	-98,580	-64,160	-29,740	4,679	39,099	73,519	107,939	142,359	176,779	211,199	245,619	280,038	314,458	346,551	377,479
Depreciation	0	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	9,975	3,325	0

In addition to the above, three kinds of indicators are calculated for the first and second measures above on the assumption that electricity tariff rises to the rate shown in Table 9-35, which is considered to be the current level in Japan. This calculation is made in order to find out the effect of electricity tariff on the financial feasibility of those measures.

Table 9-35 Assumed Rise in Electricity Rate for Study

	Assumed Electricity Rate for Study		Reference (C2 tariff)
Peak Load Rate	0.483 RM/kWh	(15 JY/kWh)	0.208 RM/kWh
Off-peak Load Rate	0.113 RM/kWh	(3.5 JY/kWh)	0.128 RM/kWh
Max. Demand Charge	49.9 RM/kW/month	(1,550 JY/kWh/month)	25.7 RM/kW/month

Table 9-36 shows the result of the evaluation at the electricity rate assumed in Table 9-35. FIRROI before tax and after tax increased by about 21% and 15%, respectively, for both measures. The payback periods were shortened by 11.3 years for an ice storage system and by 2.8 years for a VVVF system in lifts.

Table 9-36 Results of Financial Evaluation at Assumed Increased Electricity Rate

Measures	FIRROI before tax	FIRROI after tax	Payback Period
Ice Storage System	20.4%	14.5%	4.6 years
(Difference from the base)	(+21.2%)	(+15.0%)	(-11.3 years)
VVVF System in lifts	40.8%	28.6%	3.4 years
(Difference from the base)	(+21.8%)	(+15.1%)	(-2.8 years)

9-11-4 Conclusion of Financial Evaluation

According to the information obtained during the field survey, the lending rate in Malaysia has ranged from 12 to 14% per annum recently. This rate could be regarded as an indication of the opportunity cost of capital in Malaysia.

The ice storage system measure is evaluated under the assumption that it is installed at the time of chiller replacement, as mentioned before. It is concluded that the measure is not financially feasible under the conditions of the study, as its FIRROIs are negative values and its payback period is longer than 15 years. However, it is said that the measure will become financially feasible if electricity tariff increases to the current Japanese level, judging from the indicators shown in Table 9-36.

The VVVF system measure is at a marginal level of financial feasibility, assuming an inverter system is installed at the time of lift replacement. It is recommended that further investigation be made as to whether inverters should be installed or not, when lift replacement is planned. If the electricity tariff increases to the current Japanese level, its financial feasibility will be improve to the satisfactory levels shown in Table 9-36.

As for the third measure, a VAV system in the air-conditioning, FIRROIs before and after tax are 35.4% and 24.9%, respectively, which are well above the opportunity cost of capital in Malaysia, and the payback period is 3.9 years. Because of these favorable indicators, this measure can be regarded as financially feasible.

9-12 Recommendations for Energy Efficiency Promotion

Based on the energy audit and subsequent study for Mingcourt Vista Hotel, the following measures are recommended for improving its energy efficiency.

(1) Measures Requiring Investment

(a) It is recommended that a Variable Air Volume (VAV) system be installed in the hotel's air-conditioning. It can be said that this measure is financial feasible from the results of the financial evaluation.

(b) Investigation is recommended for the installation of an inverter control system in the lifts at the time of lift replacement. According to the financial evaluation, this measure is at a marginal level of financial feasibility.

(c) Although installation of an ice storage system in the hotel's chiller system is not financially feasible under the current electricity tariff of TNB, it has the potential for financial feasibility,

provided that the price of electricity increases to the current level in Japan. It is recommended that this measure be investigated in the event that electricity tariff increases in future.

(2) Measures Not Requiring Investment

(a) It is recommended that the hotel investigate increasing the temperature of its building area. The expected benefit from increasing the temperature by 2℃ is an RM 140 thousand annual saving in the electricity bill, which is the largest benefit among the recommended measures.

(3) Other Recommendations

Other recommendations are listed in Table 9-37.

Table 9-37 Other Recommendations

Category		Recommendations
Operation Management	(a)	To reduce suction air volume during air-conditioning
	(b)	To adjust suction air volume to control carbon dioxide content
	(c)	To install automatic control for air-conditioning
	(d)	To optimize setting temperature of water and air supply
	(e)	To optimize setting temperature and humidity in air-conditioned rooms
	(f)	To introduce local air-conditioning for areas where intensive air-conditioning is required
	(g)	To adjust the setting temperature and pressure of the heat source for air-conditioning
	(h)	To adjust the number of operating heat sources for air-conditioning
	(i)	To control and adjust the number of operating fans and pumps in the air-conditioning system
Maintenance Management	(a)	To inspect and repair air-leakage from the ducts
	(b)	To clean the coils and filters of air-conditioners
	(c)	To clean the condensers and evaporators of chillers
	(d)	To inspect and repair automatic control instruments
	(e)	To reinforce the monitoring system by increasing the number of measuring equipment pieces
	(f)	To clean lighting appliances and exchange old lamps
	(g)	To increase lighting efficiency by cleaning the inner surfaces of rooms
	(h)	To extinguish lights around windows
	(i)	To regularly open/close blinds
	(j)	To regularly close front & stairwell doors
	(k)	To frequently open/close windows
	(l)	To disseminate information on energy efficiency promotion and to request guests to follow it.

Appendix 9

Schedule of Specification of the Facilities and Equipment in the Hotel

Criteria for Improvement of Energy Efficiency for each Entity

Table 9-A-1 Schedule of Chiller Sets

Chiller No	Location	Type	Capacity	Evaporator				Condenser				Model
				USGPM	Water In	Water Out	Fouling Factor sq. ft °F/BTU H	USGPM	Water In	Water Out	Fouling Factor sq. ft °F/BTU H	
			USRT		°F	°F			°F	°F		
1,2,&3	Basement Main A/C Plant Room	Centrifugal	350	846	54	44	0.0005	1050	85	95	0.001	Daikin HT350H (311kW/AT each)

Table 9-A-2 Schedule of Water Pump Sets

Pump No.	Location	Type	Flow rate USGPM	Total Head Ft. of Water	Power	Model
Chilled Water Pump 1,2 &3	Basement Main A/C Plant Room	Single Stage Single Suction Vertical Split Casing	840	175	45 kw	Hitachi HDV-CH-150-125-T4-545
Condenser Water Pump 1,2 & 3	Basement Main A/C Plant Room	Single Stage Single Suction Vertical Split Casing	1050	130	45 kw	Hitachi HDV-CH-150-125-T4-545

Table 9-A-3 Schedule of Cooling Tower Sets

Cooling Tower No.	Location	Type	Flow Rate USGPM	Water		Ambient	Model
				In	Out		
1	Roof Top	3 Cells Cross Flow . Induced Draft , 2 speed fan.	1,100 each	95	85	80	Marley Model MID 327-103 25HP/15HP

Table 9-A-4 Schedule of Hot Water Boiler

Quantity	Main Specification	Manufacturers Name	Fuel	Nominal Energy Consumption	Operating Condition	
					H/Day	D/Year
2	60-90 °C 5 Bar	Hoval	Diesel Oil	0.65 G Cal/h	1st 24	365

Table 9-A-5 Schedule of Steam Boiler

Quantity	Main Specification	Manufacturers Name	Fuel	Nominal Energy Consumption	Operating Condition	
					H/Day	D/Year
2	2000 lb/hr 155 psi	Mech Mar	Diesel Oil	0.65 G Cal/h	1st 24	365

Table 9-A-6 Schedule of Energy Recovery System

Unit No	Location	Type	Supply Air		Exhaust Air		Model
			CFM	Entering Temp Dry °F	CFM	Entering Temp Dry °F	
1	roof	Q-Dot	24,260	90	13,440	76	Q-Dot Thermal Recovery Unit
2	roof	Q-Dot	38,900	90	14,720	76	Q-Dot Thermal Recovery Unit

Table 9-A-7 Schedule of Air Handling Units (as installed)

AHU No	Floor	Area Served	Type of Unit	Cooling Capacity (Btu / hr)			Air							Chilled Water (44/54)	Fan Motor			
				Sensible	Latent	Total	Total CFM	Fresh Air CFM	Total Static (in w.g)	Entering Evap		Leaving Evap			HP	Starter	Phase	Qty
										Dry °F	Wet °F	Dry °F	Wet °F	US GPM				
B-1	Basement	Foyer(Ground)	Vertical Single Zone(VSZ)	299,800	127,400	427,200	11,140	1,600	4.27	75.4	64.2	50.8	50.8	82	20	AT	3	1
B-2&B-3	1	Mechanical Plant Room	VSZ	345,210	257,990	603,200	13,840	1,810	2.35	90.0	75.6	67.2	64.4	72	15	AT	3	2
B-4	1	Housekeeping Office & Solid Diverte Room	VSZ	51,180	33,050	84,230	2,070	285	2.25	75.0	63.6	52.4	52.3	13	2	DOL	3	1
B-5	1	Housekeeping Office & Solid Diverte Room	Horizontal Single Zone (HSZ)	77,620	13,670	91,290	3,120	200	3.7	74.0	62.3	51.3	51.2	17	7.5	SD	3	1
G-1	Ground	Receiving Office & Purchasing Office	HSZ	54,910	21,830	76,740	2,100	300	2.71	75.4	64.1	51.5	51.3	15	3	DOL	3	1
G-2	Ground	Kitchen Spot Cooling	VSZ	162,000	232,200	394,200	6,020	6000	Null	80.0	65.0	65.0	63.7	79	5	SD	3	1
1-1-	First	Employee Canteen	VSZ	166,490	102,130	268,620	5,780	1,200	3.94	76.5	65.6	50.2	50.0	50	10	SD	3	1
1-2-	First	Personnel Manager Office, Clinic & Cashier Office	VSZ	103,930	54,850	158,780	3,480	920	3.13	77.5	66.6	50.2	50.2	31	5	SD	3	1
1-3-	First	Chinese Restaurant	VSZ	365,980	222,140	588,120	12,390	2,660	4.26	76.6	65.6	49.6	49.6	117	20	AT	3	1
1-4-	First	Function Rooms	VSZ	116,000	70,990	186,990	4,400	810	3.9	76.1	65.0	52.0	51.8	34	7.5	SD	3	1
1-5-	First	French Restaurant (ground)	HSZ	147,420	89,010	236,430	4,900	1,100	3.8	78.8	65.7	49.3	49.2	47	10	SD	3	1
1-6-	First	Void & Dome	VSZ	351,120	188,880	540,000	12,250	3,000	4.62	77.2	66.3	51.0	50.9	100	20	AT	3	1
1-7-	First	Kitchen Spot Cooling	VSZ	162,000	232,200	394,200	6,020	6000	Null	90.0	80.0	64.0	63.7	79	5	SD	3	1
1-8-	First	Coffee House (Ground)	HSZ	299,250	233,440	532,690	9,400	3,000	5.11	78.4	67.5	49.3	49.2	102	25	AT	3	1
1-9-	First	Bar (Ground)	HSZ	182,040	86,580	268,620	6,120	900	5.09	75.5	64.3	49.5	49.3	94	15	AT	3	1
1-10-	First	Banquetting Hall	HSZ	184,770	127,890	312,660	6,530	1,320	Null	76.8	66.0	50.6	49.5	63	5	SD	3	1
1-11-	First	Japanese Restaurant (ground)	VSZ	272,260	231,620	504,240	8,900	3,620	3.94	79.9	69.3	51.9	51.7	98	15	AT	3	1
1-12-	First	PABX, MDF & Operator room	VSZ	92,470	13,920	106,390	3,950	285	2.76	74.2	62.4	52.8	52.5	20	5	SD	3	1
1-13/1-14 1-15-	First	Banquetting Hall (first Floor)	HSZ	113,750	78,730	192,480	4,020	900	null	76.8	66.0	50.6	49.5	39	5	SD	3	3
2-1-	Second	Corridor, Bedroom & Pantry	VSZ(2 Speed)	170,020	250,000	420,020	4,170	4,710	2.71	90.0	80.0	52.0	52.0	84	7.5	SD	3	1
2-2a	Second	Banquetting Hall (first Floor)	VSZ	306,950	187,740	494,690	10,240	2,380	4.34	76.9	65.8	49.5	49.3	98	15	AT	3	1
3-1-	Third		VSZ(2 Speed)	149,460	172,940	322,400	3,430	3,430	2.7	90.0	80.0	50.2	50.2	62	5	SD	3	1
3-2-	Third		VSZ(2 Speed)	199,910	230,770	430,680	4,470	4,470	2.65	76.9	65.8	49.1	49.1	81	7.5	SD	3	1
4-1 to 11-1	Fourth to Eleven	Corridor, Bedroom & Pantry	VSZ(2 Speed)	96,450	111,080	207,530	2,310	2,310	3.16	90.0	80.0	51.8	51.8	42	5	SD	3	8
4-2-		Corridor, Bedroom & Pantry	VSZ(2 Speed)	180,270	207,110	387,380	4,280	4,280	3.4	90.0	80.0	51.5	51.5	77	7.5	SD	3	1
5-2-		Same As Above	VSZ(2 Speed)	169,370	196,550	365,920	3,980	3,980	3.18	90.0	80.0	51.1	51.1	72	7.5	SD	3	1
6-2-		Same As Above	VSZ(3 Speed)	162,960	187,650	350,610	3,800	3,800	3.03	90.0	80.0	50.8	50.8	69	5	SD	3	1
7-2-		Same As Above	VSZ(4 Speed)	155,540	174,500	330,040	3,500	3,500	2.82	90.0	80.0	49.9	49.9	63	5	SD	3	1
8-2-		Same As Above	VSZ(5 Speed)	135,740	156,350	292,090	3,200	3,200	3.4	90.0	80.0	52.4	52.4	59	5	SD	3	1
9-2-		Same As Above	VSZ(6 Speed)	126,870	144,530	271,400	3,020	3,020	3.21	90.0	80.0	51.6	51.6	55	5	SD	3	1
10-2/11-2		Same As Above	VSZ(7 Speed)	111,740	137,070	248,810	2,720	2,720	2.91	90.0	80.0	52.5	52.5	49	3	SD	3	2
12-1-		Same As Above	VSZ(8 Speed)	96,150	115,400	211,550	2,350	2,350	2.56	90.0	80.0	52.6	52.6	42	3	SD	3	1
12-2-		Same As Above	VSZ(9 Speed)	106,940	131,840	238,780	2,500	2,500	2.7	90.0	80.0	50.9	50.9	45	3	SD	3	1

Table 9-A-8 Schedule of Fan Coil Units (as installed)

Type	CAPACITY BTUH			AIR					CHILLED WATER 44/54 US GPM
	Sensible	Latent	Total	Total CFM	Primary Air	Fresh Air	Entering Coil Dry °F	Entering Coil Wet °F	
A	7,400	1,000	8,400	400	90	Nil	73.0	61.0	1.5
B	7,643	1,157	8,800	400	90	Nil	73.0	61.0	1.7
B1	9,200	1,200	10,400	450	Nil	90	73.0	61.0	1.7
C	11,300	1,400	12,700	600	90	Nil	73.0	61.0	2.3
D	11,040	5,650	16,690	600	Nil	90	76.1	65.0	4.7
E	11,100	1,100	12,200	600	100 (2nd Floor Only) 90 (Other Floors)	Nil	73.0	61.0	2.1
F	12,100	2,000	14,100	600	90	Nil	73.0	61.0	2.8
F1	18,100	12,000	30,100	750	Nil	100	73.0	61.0	3.2
G	15,700	1,600	17,300	800	100 (2nd Floor Only) 90 (Other Floors)	Nil	73.0	61.0	3.2
H	15,900	2,000	17,900	800	90	Nil	73.0	61.0	3.4
IA	22,100	3,800	25,900	1200	Nil	90	73.0	63.2	4.5
J	21,600	2,900	24,500	1200	90	Nil	74.9	61.0	4.0
K	25,900	10,830	36,730	1050	Nil	80	73.0	65.0	7.1
K1		3,500	3,500	1400	Nil	180	76.1	61.0	7.1
L	21,950	3,350	25,300	1200	100 (2nd Floor Only) 90 (Other Floors)	Nil	73.0	61.0	4.3
R1,R2&R3	45,300	18,500	63,800	1800	Nil	90	73.3	61.3	20.0

Table 9-A-9-1 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	Base	Central Control Room	B1	SINKO ECR-400 HW		
	Base	Hotel Engineer	K1	SINKO ECR-1400 SW		
	Base	Service Lobby	D	NATIONAL BV-600 CE3		
	Base	Laundry Manager Office	B1	SINKO ECR-400 HW		
	Base	Red Wine	F1	SINKO ECR-600 SW		
	Base	White Wine	F	NATIONAL BV-600 CE3		
	Ground	Service Lobby	D	NATIONAL BV-600 CE3		
	F1	Computer Room	K	NATIONAL BV-303 CMY		
	F1	Service Lobby	K	NATIONAL BV-303 CMY		
	F1	Function Room	K1	SINKO ECR-1400 SW		
	F1	Function Room	G	NATIONAL BV-800 CE3		
	F1	Function Room	K1	SINKO ECR-1400 SW		
	F1	Function Room	G	NATIONAL BV-800 CE3		
	F1	Function Room	K	NATIONAL BV-303 CMY		
	F2	R249	E	NATIONAL BV-600 CE3	B	
	F2	R251	E+L	N-BV-600 CE3 + N-BV-1200 CE3	B	
	F2	R240	H	NATIONAL BV-800 CE3	A	
	F2	R242	H	NATIONAL BV-800 CE3	A	
	F2	R245	E	NATIONAL BV-600 CE3	D	
	F2	R247	E	NATIONAL BV-600 CE3	D	
	F2	R238	H	NATIONAL BV-800 CE3	C	
	F2	R241	E	NATIONAL BV-600 CE3	F	
	F2	R243	E	NATIONAL BV-600 CE3	F	
	F2	R234	H	NATIONAL BV-800 CE3	E	
	F2	R236	H	NATIONAL BV-800 CE3	E	
	F2	R237	E	NATIONAL BV-600 CE3	H	
	F2	R239	E	NATIONAL BV-600 CE3	H	
	F2	R233	L+E	N-BV-1200 CE3 + N-BV-600 CE3	J	
	F2	R235	E	NATIONAL BV-600 CE3	J	
	F2	R229	G	NATIONAL BV-800 CE3	M-1	
	F2	R231	G	NATIONAL BV-800 CE3	M-1	
	F2	R226	J	NATIONAL BV-1200 CE3	L	
	F2	R228	H	NATIONAL BV-800 CE3	L	

Table 9-A-9-2 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F2	R225	G	NATIONAL BV-800 CE3	M	
	F2	R227	G	NATIONAL BV-800 CE3	M	
	F2	R222	H	NATIONAL BV-800 CE3	N	
	F2	R224	H	NATIONAL BV-800 CE3	N	
	F2	R221	G	NATIONAL BV-800 CE3	P	
	F2	R223	G	NATIONAL BV-800 CE3	P	
	F2	R218	H	NATIONAL BV-800 CE3	Q	
	F2	R220	J	NATIONAL BV-1200 CE3	Q	
	F2	R217	G	NATIONAL BV-800 CE3	R	
	F2	R219	G+K	N- BV-800 CE3+N-BV-303 CMY	R	
	F2	R214	H	NATIONAL BV-800 CE3	S	
	F2	R216	F	NATIONAL BV-600 CE3	S	
	F2	R213	G	NATIONAL BV-800 CE3	T	
	F2	R215	IA	NATIONAL BV-1200 CE3	T	
	F2	R210	F	NATIONAL BV-600 CE3	U	
	F2	R212	H	NATIONAL BV-800 CE3	U	
	F2	R209	IA	NATIONAL BV-800 CE3	V	
	F2	R211	KI	SINKO ECR-1400, SW	V	
	F2	Service & Stair Lobby	K	NATIONAL BV-303 CMY		
	F2	Pool Manager	F	NATIONAL BV-600 CE3		
	F2	Reception Facial Treatment	IA	NATIONAL BV-800 CE3		
	F2	Hair Dressing Saloon	IA	NATIONAL BV-800 CE3		
	F3	R349	A	NATIONAL BV-400 CE3	B	
	F3	R351	H	NATIONAL BV-800 CE3	B	
	F3	R340	B	NATIONAL BV-400 CE3	A	
	F3	R342	B	NATIONAL BV-400 CE3	A	
	F3	R344	G	NATIONAL BV-800 CE3	A	
	F3	R345	A	NATIONAL BV-400 CE3	D	
	F3	R347	A	NATIONAL BV-400 CE3	D	
	F3	R338	E	NATIONAL BV-600 CE3	C	
	F3	R341	A	NATIONAL BV-400 CE3	F	
	F3	R343	A	NATIONAL BV-400 CE3	F	
	F3	R334	B	NATIONAL BV-400 CE3	E	

Table 9-A-9-3 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F3	R336	E	NATIONAL BV-600 CE3	E	
	F3	R337	A	NATIONAL BV-400 CE3	H	
	F3	R339	A	NATIONAL BV-400 CE3	H	
	F3	R332	B	NATIONAL BV-400 CE3	G	
	F3	R333	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F3	R335	A	NATIONAL BV-400 CE3	J	
	F3	R330	B	NATIONAL BV-400 CE3	L-1	
	F3	R329	E	NATIONAL BV-600 CE3	M-1	
	F3	R331	B	NATIONAL BV-400 CE3	M-1	
	F3	R326	E	NATIONAL BV-600 CE3	L	
	F3	R328	E	NATIONAL BV-600 CE3	L	
	F3	R325	B	NATIONAL BV-400 CE3	M	
	F3	R327	B	NATIONAL BV-400 CE3	M	
	F3	R322	E	NATIONAL BV-600 CE3	N	
	F3	R324	E	NATIONAL BV-600 CE3	N	
	F3	R321	B	NATIONAL BV-400 CE3	P	
	F3	R323	B	NATIONAL BV-400 CE3	P	
	F3	R318	E	NATIONAL BV-600 CE3	Q	
	F3	R320	H	NATIONAL BV-800 CE3	Q	
	F3	R317	B	NATIONAL BV-400 CE3	R	
	F3	R319	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F3	R314	C	NATIONAL BV-600 CE3	S	
	F3	R316	C	NATIONAL BV-600 CE3	S	
	F3	R313	A	NATIONAL BV-400 CE3	T	
	F3	R315	A	NATIONAL BV-400 CE3	T	
	F3	R310	C	NATIONAL BV-600 CE3	U	
	F3	R312	C	NATIONAL BV-600 CE3	U	
	F3	R309	A	NATIONAL BV-400 CE3	V	
	F3	R311	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F3	R306	F	NATIONAL BV-600 CE3	W	
	F3	R308	F	NATIONAL BV-600 CE3	W	
	F3	R305	B	NATIONAL BV-400 CE3	X	
	F3	R307	B	NATIONAL BV-400 CE3	X	

Table 9-A-9-4 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F3	R302	F	NATIONAL BV-600 CE3	Y	
	F3	R304	F	NATIONAL BV-600 CE3	Y	
	F3	R301	B	NATIONAL BV-400 CE3	Z	
	F3	R303	E	NATIONAL BV-600 CE3	Z	
	F4	R449	H	NATIONAL BV-800 CE3	B	
	F4	R440	H	NATIONAL BV-800 CE3	A	
	F4	R442	B	NATIONAL BV-400 CE3	A	
	F4	R445	A	NATIONAL BV-400 CE3	D	
	F4	R447	A	NATIONAL BV-400 CE3	D	
	F4	R438	E	NATIONAL BV-600 CE3	C	
	F4	R441	A	NATIONAL BV-400 CE3	F	
	F4	R443	A	NATIONAL BV-400 CE3	F	
	F4	R434	B	NATIONAL BV-400 CE3	E	
	F4	R436	E	NATIONAL BV-600 CE3	E	
	F4	R437	A	NATIONAL BV-400 CE3	H	
	F4	R439	A	NATIONAL BV-400 CE3	H	
	F4	R432	B	NATIONAL BV-400 CE3	G	
	F4	R433	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F4	R435	A	NATIONAL BV-400 CE3	J	
	F4	R430	B	NATIONAL BV-400 CE3	L-1	
	F4	R429	E	NATIONAL BV-600 CE3	M-1	
	F4	R431	B	NATIONAL BV-400 CE3	M-1	
	F4	R426	E	NATIONAL BV-600 CE3	L	
	F4	R428	E	NATIONAL BV-600 CE3	L	
	F4	R425	B	NATIONAL BV-400 CE3	M	
	F4	R427	B	NATIONAL BV-400 CE3	M	
	F4	R422	E	NATIONAL BV-600 CE3	N	
	F4	R424	E	NATIONAL BV-600 CE3	N	
	F4	R421	B	NATIONAL BV-400 CE3	P	
	F4	R423	B	NATIONAL BV-400 CE3	P	
	F4	R418	E	NATIONAL BV-600 CE3	Q	
	F4	R420	H	NATIONAL BV-800 CE3	Q	
	F4	R417	B	NATIONAL BV-400 CE3	R	

Table 9-A-9-5 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F4	R419	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F4	R414	C	NATIONAL BV-600 CE3	S	
	F4	R416	A	NATIONAL BV-400 CE3	S	
	F4	R413	A	NATIONAL BV-400 CE3	T	
	F4	R415	A	NATIONAL BV-400 CE3	T	
	F4	R410	A	NATIONAL BV-400 CE3	U	
	F4	R412	C	NATIONAL BV-600 CE3	U	
	F4	R409	A	NATIONAL BV-400 CE3	V	
	F4	R411	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F4	R406	F	NATIONAL BV-600 CE3	W	
	F4	R408	F	NATIONAL BV-600 CE3	W	
	F4	R405	B	NATIONAL BV-400 CE3	X	
	F4	R407	B	NATIONAL BV-400 CE3	X	
	F4	R402	F	NATIONAL BV-600 CE3	Y	
	F4	R404	F	NATIONAL BV-600 CE3	Y	
	F4	R401	B	NATIONAL BV-400 CE3	Z	
	F4	R403	E	NATIONAL BV-600 CE3	Z	
	F5	R540	H	NATIONAL BV-800 CE3	A	
	F5	R545	A	NATIONAL BV-400 CE3	D	
	F5	R547	H	NATIONAL BV-800 CE3	D	
	F5	R538	E	NATIONAL BV-600 CE3	C	
	F5	R541	A	NATIONAL BV-400 CE3	F	
	F5	R543	A	NATIONAL BV-400 CE3	F	
	F5	R534	B	NATIONAL BV-400 CE3	E	
	F5	R536	E	NATIONAL BV-600 CE3	E	
	F5	R537	A	NATIONAL BV-400 CE3	H	
	F5	R539	A	NATIONAL BV-400 CE3	H	
	F5	R532	B	NATIONAL BV-400 CE3	G	
	F5	R533	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F5	R535	A	NATIONAL BV-400 CE3	J	
	F5	R530	B	NATIONAL BV-400 CE3	L-1	
	F5	R529	E	NATIONAL BV-600 CE3	M-1	
	F5	R531	B	NATIONAL BV-400 CE3	M-1	

Table 9-A-9-6 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F5	R526	E	NATIONAL BV-600 CE3	L	
	F5	R528	E	NATIONAL BV-600 CE3	L	
	F5	R525	B	NATIONAL BV-400 CE3	M	
	F5	R527	B	NATIONAL BV-400 CE3	M	
	F5	R522	E	NATIONAL BV-600 CE3	N	
	F5	R524	E	NATIONAL BV-600 CE3	N	
	F5	R521	B	NATIONAL BV-400 CE3	P	
	F5	R523	B	NATIONAL BV-400 CE3	P	
	F5	R518	E	NATIONAL BV-600 CE3	Q	
	F5	R520	H	NATIONAL BV-800 CE3	Q	
	F5	R517	B	NATIONAL BV-400 CE3	R	
	F5	R519	B+K	N-BV-400 CE3 + N- BV-303 CMY	R	
	F5	R514	C	NATIONAL BV-600 CE3	S	
	F5	R516	A	NATIONAL BV-400 CE3	S	
	F5	R513	A	NATIONAL BV-400 CE3	T	
	F5	R515	A	NATIONAL BV-400 CE3	T	
	F5	R510	A	NATIONAL BV-400 CE3	U	
	F5	R512	C	NATIONAL BV-600 CE3	U	
	F5	R509	A	NATIONAL BV-400 CE3	V	
	F5	R511	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F5	R506	F	NATIONAL BV-600 CE3	W	
	F5	R508	F	NATIONAL BV-600 CE3	W	
	F5	R505	B	NATIONAL BV-400 CE3	X	
	F5	R507	B	NATIONAL BV-400 CE3	X	
	F5	R502	F	NATIONAL BV-600 CE3	Y	
	F5	R504	F	NATIONAL BV-600 CE3	Y	
	F5	R501	B	NATIONAL BV-400 CE3	Z	
	F5	R503	E	NATIONAL BV-600 CE3	Z	
	F6	R645	H	NATIONAL BV-800 CE3	D	
	F6	R638	H	NATIONAL BV-800 CE3	C	
	F6	R641	A	NATIONAL BV-400 CE3	F	
	F6	R643	A	NATIONAL BV-400 CE3	F	
	F6	R634	B	NATIONAL BV-400 CE3	E	

Table 9-A-9-7 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F6	R636	E	NATIONAL BV-600 CE3	E	
	F6	R637	A	NATIONAL BV-400 CE3	H	
	F6	R639	A	NATIONAL BV-400 CE3	H	
	F6	R632	B	NATIONAL BV-400 CE3	G	
	F6	R633	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F6	R635	A	NATIONAL BV-400 CE3	J	
	F6	R630	B	NATIONAL BV-400 CE3	L-1	
	F6	R629	E	NATIONAL BV-600 CE3	M-1	
	F6	R631	B	NATIONAL BV-400 CE3	M-1	
	F6	R626	E	NATIONAL BV-600 CE3	L	
	F6	R628	E	NATIONAL BV-600 CE3	L	
	F6	R625	B	NATIONAL BV-400 CE3	M	
	F6	R627	B	NATIONAL BV-400 CE3	M	
	F6	R622	E	NATIONAL BV-600 CE3	N	
	F6	R624	E	NATIONAL BV-600 CE3	N	
	F6	R621	B	NATIONAL BV-400 CE3	P	
	F6	R623	B	NATIONAL BV-400 CE3	P	
	F6	R618	E	NATIONAL BV-600 CE3	Q	
	F6	R620	H	NATIONAL BV-800 CE3	Q	
	F6	R617	B	NATIONAL BV-400 CE3	R	
	F6	R619	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F6	R614	C	NATIONAL BV-600 CE3	S	
	F6	R616	A	NATIONAL BV-400 CE3	S	
	F6	R613	A	NATIONAL BV-400 CE3	T	
	F6	R615	A	NATIONAL BV-400 CE3	T	
	F6	R610	A	NATIONAL BV-400 CE3	U	
	F6	R612	C	NATIONAL BV-600 CE3	U	
	F6	R609	A	NATIONAL BV-400 CE3	V	
	F6	R611	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F6	R606	F	NATIONAL BV-600 CE3	W	
	F6	R608	F	NATIONAL BV-600 CE3	W	
	F6	R605	B	NATIONAL BV-400 CE3	X	
	F6	R607	B	NATIONAL BV-400 CE3	X	

Table 9-A-9-8 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F6	R602	F	NATIONAL BV-600 CE3	Y	
	F6	R604	F	NATIONAL BV-600 CE3	Y	
	F6	R601	B	NATIONAL BV-400 CE3	Z	
	F6	R603	E	NATIONAL BV-600 CE3	Z	
	F7	R741	A	NATIONAL BV-400 CE3	F	
	F7	R743	H	NATIONAL BV-800 CE3	F	
	F7	R734	B	NATIONAL BV-400 CE3	E	
	F7	R736	H	NATIONAL BV-800 CE3	E	
	F7	R737	A	NATIONAL BV-400 CE3	H	
	F7	R739	A	NATIONAL BV-400 CE3	H	
	F7	R732	B	NATIONAL BV-400 CE3	G	
	F7	R733	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F7	R735	A	NATIONAL BV-400 CE3	J	
	F7	R730	B	NATIONAL BV-400 CE3	L-1	
	F7	R729	E	NATIONAL BV-600 CE3	M-1	
	F7	R731	B	NATIONAL BV-400 CE3	M-1	
	F7	R726	E	NATIONAL BV-600 CE3	L	
	F7	R728	E	NATIONAL BV-600 CE3	L	
	F7	R725	B	NATIONAL BV-400 CE3	M	
	F7	R727	B	NATIONAL BV-400 CE3	M	
	F7	R722	E	NATIONAL BV-600 CE3	N	
	F7	R724	E	NATIONAL BV-600 CE3	N	
	F7	R721	B	NATIONAL BV-400 CE3	P	
	F7	R723	B	NATIONAL BV-400 CE3	P	
	F7	R718	E	NATIONAL BV-600 CE3	Q	
	F7	R720	H	NATIONAL BV-800 CE3	Q	
	F7	R717	B	NATIONAL BV-400 CE3	R	
	F7	R719	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F7	R714	C	NATIONAL BV-600 CE3	S	
	F7	R716	A	NATIONAL BV-400 CE3	S	
	F7	R713	A	NATIONAL BV-400 CE3	T	
	F7	R715	A	NATIONAL BV-400 CE3	T	
	F7	R710	A	NATIONAL BV-400 CE3	U	

Table 9-A-9-9 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F7	R712	C	NATIONAL BV-600 CE3	U	
	F7	R709	A	NATIONAL BV-400 CE3	V	
	F7	R711	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F7	R706	F	NATIONAL BV-600 CE3	W	
	F7	R708	A	NATIONAL BV-400 CE3	W	
	F7	R705	B	NATIONAL BV-400 CE3	X	
	F7	R707	B	NATIONAL BV-400 CE3	X	
	F7	R702	A	NATIONAL BV-400 CE3	Y	
	F7	R704	A	NATIONAL BV-400 CE3	Y	
	F7	R701	B	NATIONAL BV-400 CE3	Z	
	F7	R703	E	NATIONAL BV-600 CE3	Z	
	F8	R841	H	NATIONAL BV-800 CE3	F	
	F8	R843	H	NATIONAL BV-800 CE3	E	
	F8	R837	A	NATIONAL BV-400 CE3	H	
	F8	R839	A	NATIONAL BV-400 CE3	H	
	F8	R832	B	NATIONAL BV-400 CE3	G	
	F8	R833	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F8	R835	A	NATIONAL BV-400 CE3	J	
	F8	R830	B	NATIONAL BV-400 CE3	L-1	
	F8	R829	E	NATIONAL BV-600 CE3	M-1	
	F8	R831	B	NATIONAL BV-400 CE3	M-1	
	F8	R826	E	NATIONAL BV-600 CE3	L	
	F8	R828	E	NATIONAL BV-600 CE3	L	
	F8	R825	B	NATIONAL BV-400 CE3	M	
	F8	R827	B	NATIONAL BV-400 CE3	M	
	F8	R822	E	NATIONAL BV-600 CE3	N	
	F8	R824	E	NATIONAL BV-600 CE3	N	
	F8	R821	B	NATIONAL BV-400 CE3	P	
	F8	R823	B	NATIONAL BV-400 CE3	P	
	F8	R818	E	NATIONAL BV-600 CE3	Q	
	F8	R820	H	NATIONAL BV-800 CE3	Q	
	F8	R817	B	NATIONAL BV-400 CE3	R	
	F8	R819	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	

Table 9-A-9-10 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F8	R814	C	NATIONAL BV-600 CE3	S	
	F8	R816	A	NATIONAL BV-400 CE3	S	
	F8	R813	A	NATIONAL BV-400 CE3	T	
	F8	R815	A	NATIONAL BV-400 CE3	T	
	F8	R810	A	NATIONAL BV-400 CE3	U	
	F8	R812	C	NATIONAL BV-600 CE3	U	
	F8	R809	A	NATIONAL BV-400 CE3	V	
	F8	R811	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F8	R806	F	NATIONAL BV-600 CE3	W	
	F8	R808	A	NATIONAL BV-400 CE3	W	
	F8	R805	B	NATIONAL BV-400 CE3	X	
	F8	R807	B	NATIONAL BV-400 CE3	X	
	F8	R802	A	NATIONAL BV-400 CE3	Y	
	F8	R804	A	NATIONAL BV-400 CE3	Y	
	F8	R801	B	NATIONAL BV-400 CE3	Z	
	F8	R803	E	NATIONAL BV-600 CE3	Z	
	F9	R937	A	NATIONAL BV-400 CE3	H	
	F9	R939	H	NATIONAL BV-800 CE3	H	
	F9	R932	H	NATIONAL BV-800 CE3	G	
	F9	R933	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F9	R935	A	NATIONAL BV-400 CE3	J	
	F9	R930	B	NATIONAL BV-400 CE3	L-1	
	F9	R929	E	NATIONAL BV-600 CE3	M-1	
	F9	R931	B	NATIONAL BV-400 CE3	M-1	
	F9	R926	E	NATIONAL BV-600 CE3	L	
	F9	R928	E	NATIONAL BV-600 CE3	L	
	F9	R925	B	NATIONAL BV-400 CE3	M	
	F9	R927	B	NATIONAL BV-400 CE3	M	
	F9	R922	E	NATIONAL BV-600 CE3	N	
	F9	R924	E	NATIONAL BV-600 CE3	N	
	F9	R921	B	NATIONAL BV-400 CE3	P	
	F9	R923	B	NATIONAL BV-400 CE3	P	
	F9	R918	E	NATIONAL BV-600 CE3	Q	

Table 9-A-9-11 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F9	R920	H	NATIONAL BV-800 CE3	Q	
	F9	R917	B	NATIONAL BV-400 CE3	R	
	F9	R919	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F9	R914	C	NATIONAL BV-600 CE3	S	
	F9	R916	A	NATIONAL BV-400 CE3	S	
	F9	R913	A	NATIONAL BV-400 CE3	T	
	F9	R915	A	NATIONAL BV-400 CE3	T	
	F9	R910	A	NATIONAL BV-400 CE3	U	
	F9	R912	C	NATIONAL BV-600 CE3	U	
	F9	R909	A	NATIONAL BV-400 CE3	V	
	F9	R911	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F9	R906	F	NATIONAL BV-600 CE3	W	
	F9	R908	A	NATIONAL BV-400 CE3	W	
	F9	R905	B	NATIONAL BV-400 CE3	X	
	F9	R907	B	NATIONAL BV-400 CE3	X	
	F9	R902	A	NATIONAL BV-400 CE3	Y	
	F9	R904	A	NATIONAL BV-400 CE3	Y	
	F9	R901	B	NATIONAL BV-400 CE3	Z	
	F9	R903	E	NATIONAL BV-600 CE3	Z	
	F10	R1037	G	NATIONAL BV-800 CE3	H	
	F10	R1033	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F10	R1035	A	NATIONAL BV-400 CE3	J	
	F10	R1030	B	NATIONAL BV-400 CE3	L-1	
	F10	R1029	E	NATIONAL BV-600 CE3	M-1	
	F10	R1031	B	NATIONAL BV-400 CE3	M-1	
	F10	R1026	E	NATIONAL BV-600 CE3	L	
	F10	R1028	E	NATIONAL BV-600 CE3	L	
	F10	R1025	B	NATIONAL BV-400 CE3	M	
	F10	R1027	B	NATIONAL BV-400 CE3	M	
	F10	R1022	E	NATIONAL BV-600 CE3	N	
	F10	R1024	E	NATIONAL BV-600 CE3	N	
	F10	R1021	B	NATIONAL BV-400 CE3	P	
	F10	R1023	B	NATIONAL BV-400 CE3	P	

Table 9-A-9-12 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F10	R1018	E	NATIONAL BV-600 CE3	Q	
	F10	R1020	H	NATIONAL BV-800 CE3	Q	
	F10	R1017	B	NATIONAL BV-400 CE3	R	
	F10	R1019	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F10	R1014	C	NATIONAL BV-600 CE3	S	
	F10	R1016	A	NATIONAL BV-400 CE3	S	
	F10	R1013	A	NATIONAL BV-400 CE3	T	
	F10	R1015	A	NATIONAL BV-400 CE3	T	
	F10	R1010	A	NATIONAL BV-400 CE3	U	
	F10	R1012	C	NATIONAL BV-600 CE3	U	
	F10	R1009	A	NATIONAL BV-400 CE3	V	
	F10	R1011	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F10	R1006	F	NATIONAL BV-600 CE3	W	
	F10	R1008	A	NATIONAL BV-400 CE3	W	
	F10	R1005	B	NATIONAL BV-400 CE3	X	
	F10	R1007	B	NATIONAL BV-400 CE3	X	
	F10	R1002	A	NATIONAL BV-400 CE3	Y	
	F10	R1004	A	NATIONAL BV-400 CE3	Y	
	F10	R1001	B	NATIONAL BV-400 CE3	Z	
	F10	R1003	E	NATIONAL BV-600 CE3	Z	
	F11	R1137	G	NATIONAL BV-800 CE3	H	
	F11	R1133	L+A	N-BV-1200 CE3 + N-BV-400 CE3	J	
	F11	R1135	A	NATIONAL BV-400 CE3	J	
	F11	R1130	B	NATIONAL BV-400 CE3	L-1	
	F11	R1129	E	NATIONAL BV-600 CE3	M-1	
	F11	R1131	B	NATIONAL BV-400 CE3	M-1	
	F11	R1126	E	NATIONAL BV-600 CE3	L	
	F11	R1128	E	NATIONAL BV-600 CE3	L	
	F11	R1125	B	NATIONAL BV-400 CE3	M	
	F11	R1127	B	NATIONAL BV-400 CE3	M	
	F11	R1122	E	NATIONAL BV-600 CE3	N	
	F11	R1124	E	NATIONAL BV-600 CE3	N	
	F11	R1121	B	NATIONAL BV-400 CE3	P	

Table 9-A-9-13 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F11	R1123	B	NATIONAL BV-400 CE3	P	
	F11	R1118	E	NATIONAL BV-600 CE3	Q	
	F11	R1120	H	NATIONAL BV-800 CE3	Q	
	F11	R1117	B	NATIONAL BV-400 CE3	R	
	F11	R1119	B+K	N-BV-400 CE3 + N-BV-303 CMY	R	
	F11	R1114	C	NATIONAL BV-600 CE3	S	
	F11	R1116	A	NATIONAL BV-400 CE3	S	
	F11	R1113	A	NATIONAL BV-400 CE3	T	
	F11	R1115	A	NATIONAL BV-400 CE3	T	
	F11	R1110	A	NATIONAL BV-400 CE3	U	
	F11	R1112	C	NATIONAL BV-600 CE3	U	
	F11	R1109	A	NATIONAL BV-400 CE3	V	
	F11	R1111	A+D	N-BV-400 CE3 + N-BV-600 CE3	V	
	F11	R1106	F	NATIONAL BV-600 CE3	W	
	F11	R1108	A	NATIONAL BV-400 CE3	W	
	F11	R1105	B	NATIONAL BV-400 CE3	X	
	F11	R1107	B	NATIONAL BV-400 CE3	X	
	F11	R1102	A	NATIONAL BV-400 CE3	Y	
	F11	R1104	A	NATIONAL BV-400 CE3	Y	
	F11	R1101	B	NATIONAL BV-400 CE3	Z	
	F11	R1103	E	NATIONAL BV-600 CE3	Z	
	F12	(R1233)	F	NATIONAL BV-600 CE3	H	
	F12	R1233	F	NATIONAL BV-600 CE3	J	
	F12	(R1233)	KI	SINKO ECR-1400 SW	J	
	F12	(R1233)	E	NATIONAL BV-600 CE3	L-1	
	F12	(R1233)	E	NATIONAL BV-600 CE3	L-1	
	F12	R1229	E	NATIONAL BV-600 CE3	M-1	
	F12	R1231	E	NATIONAL BV-600 CE3	M-1	
	F12	R1226	E	NATIONAL BV-600 CE3	L	
	F12	R1228	E	NATIONAL BV-600 CE3	L	
	F12	R1225	E	NATIONAL BV-600 CE3	M	
	F12	R1227	E	NATIONAL BV-600 CE3	M	
	F12	(R1224)	E	NATIONAL BV-600 CE3	N	

Table 9-A-9-14 Fan Coil Unit

No	Floor	Location	Type	Specification	Stack No	Others & Reference
	F12	R1224	E	NATIONAL BV-600 CE3	N	
	F12	(R1223)	E	NATIONAL BV-600 CE3	P	
	F12	R1223	E	NATIONAL BV-600 CE3	P	
	F12	R1218	E	NATIONAL BV-600 CE3	Q	
	F12	(R1218)	H	NATIONAL BV-800 CE3	Q	
	F12	R1217	E	NATIONAL BV-600 CE3	R	
	F12	(R1217)	G+K	N-BV-800 CE3 + N-BV-303 CMY	R	
	F12	(R1216)	F	NATIONAL BV-600 CE3	S	
	F12	R1216	B	NATIONAL BV-400 CE3	S	
	F12	(R1215)	G	NATIONAL BV-800 CE3	T	
	F12	R1215	B	NATIONAL BV-400 CE3	T	
	F12	R1210	B	NATIONAL BV-400 CE3	U	
	F12	(R1210)	F	NATIONAL BV-600 CE3	U	
	F12	R1209	B	NATIONAL BV-400 CE3	V	
	F12	(R1209)	G+D	N-BV-800 CE3 + N- BV-600 CE3	V	
	F12	R1206	F	NATIONAL BV-600 CE3	W	
	F12	R1208	B	NATIONAL BV-400 CE3	W	
	F12	R1205	G	NATIONAL BV-800 CE3	X	
	F12	R1207	E	NATIONAL BV-600 CE3	X	
	F12	R1202	B	NATIONAL BV-400 CE3	Y	
	F12	R1204	E	NATIONAL BV-600 CE3	Y	
	F12	R1201	E	NATIONAL BV-600 CE3	Z	
	F12	R1203	G	NATIONAL BV-800 CE3	Z	
	Roof	Office Area FCUR3	R3	SINKO MH 504		
	Roof	Office Area FCUR2	R2	SINKO MH 504		
	Roof	Office Area FCUR1	R1	SINKO MH 504		
	Roof	Guest Lift Motor Control Room	KI	SINKO ECR-1400 SW		
	Roof	Service Lift Motor Control Room	KI	SINKO ECR-1400 SW		